The Dock & Harbour Authority

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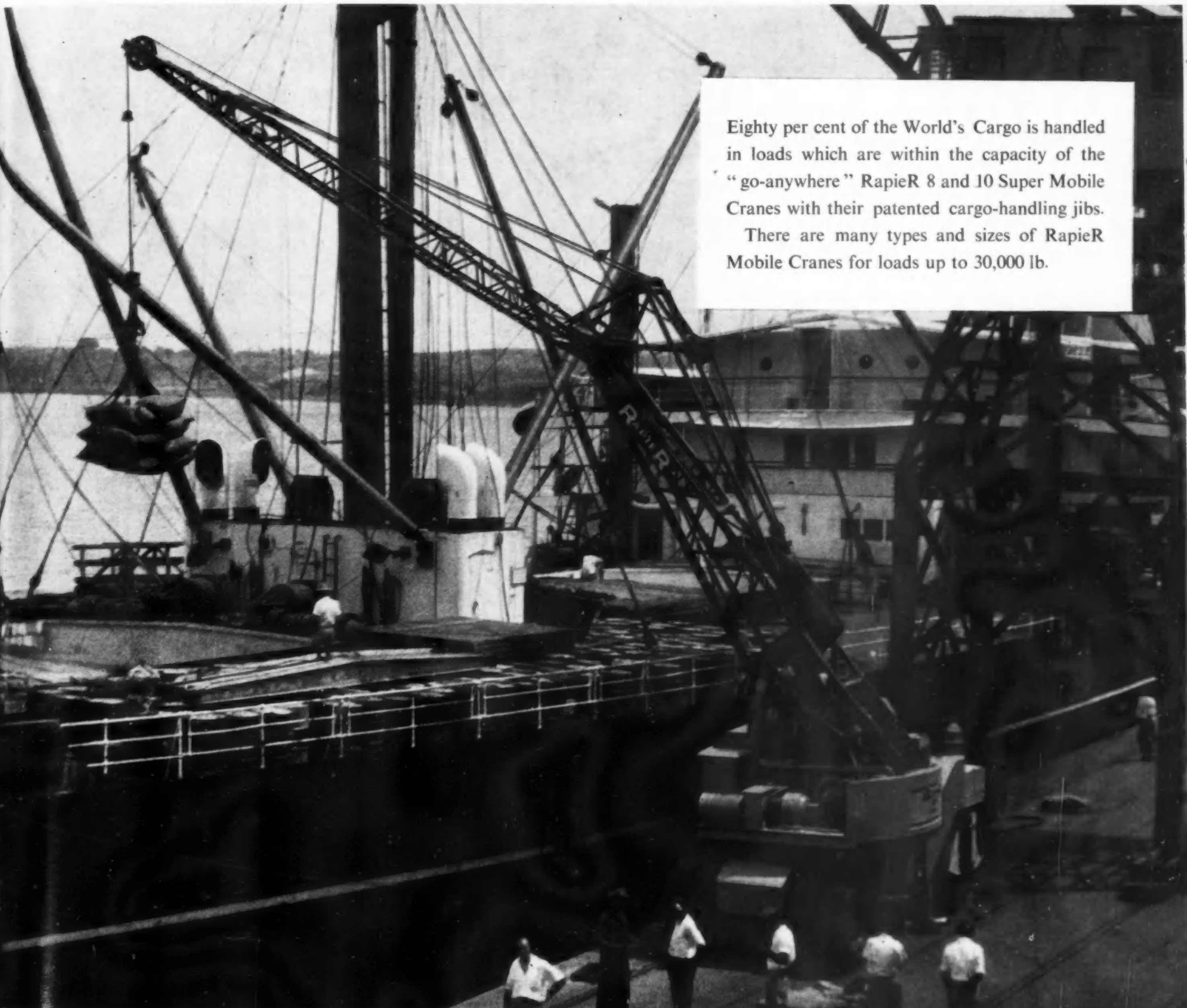

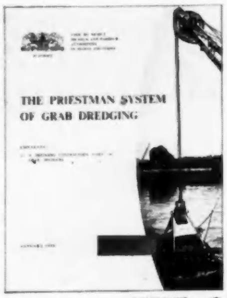

Accurate Dredging*

* The M.B. Dredging Co. Ltd., of London

received, in a report published by the Medway Conservancy Board, generous praise for their work (on which Priestman Dredgers were used exclusively) on Rochester Harbour. The Harbour Master concluded this report by saying "Experience has proved that it is quite practicable to dredge with the above equipment to within 6 in. of a predetermined level and also to cut slopes to a given gradient".

The Rochester Harbour project involved the removal of some 400,000 cu. yds. of difficult material; deepening and extending berths to enable 450 ft. vessels of 25 ft. draught to be moored afloat at all stages of the tide. Accurately-graded slopes of 1 in 2 were called for in places, and were accomplished satisfactorily as was proved by an "After-Dredging Survey Plan". Such accuracy would have been impossible without the Priestman "Underwater Eyes"; although tribute must be paid to the efficient use of this feature.

Other interesting contracts carried out by M.B. Dredging Co. Ltd. with Priestman Dredgers include such tasks as cutting cross-river trenches for electric cables and, after the laying of the cable, refilling the trench.

PRIESTMAN

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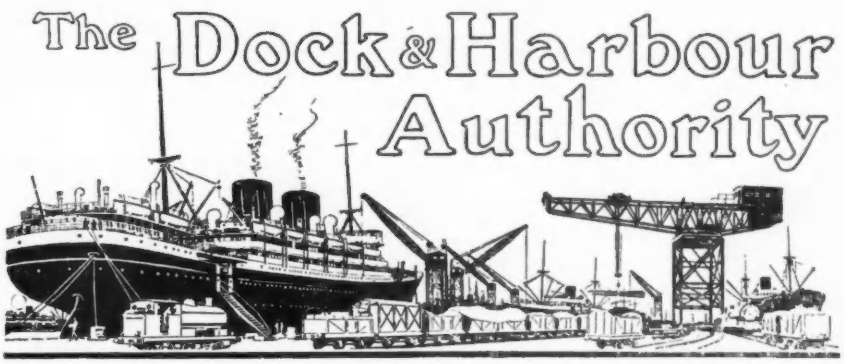

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Vol. XL

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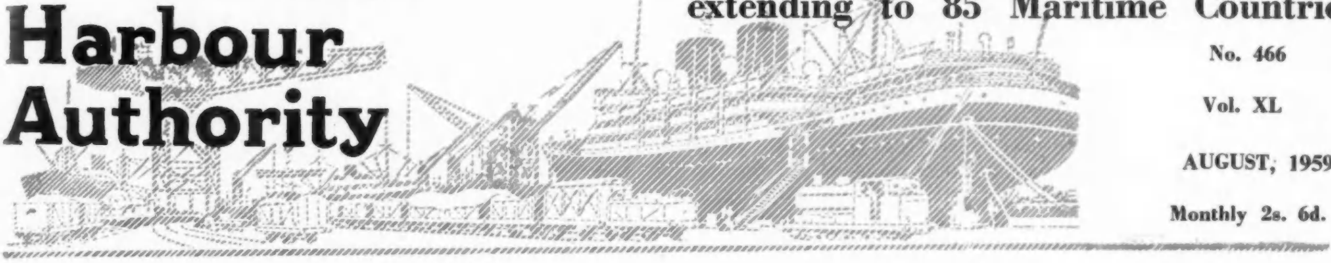


Editorial Notes

New Oil Jetties at Thames Haven

A major development of the existing oil handling and storage facilities at Thames Haven was completed at the beginning of this year. The development included an expansion of the existing berthing facilities by the commissioning of two oil receiving and loading jetties capable of handling tankers of up to 80,000 deadweight tons, and it is the design and construction of these jetties that our leading article for this month discusses in detail.

The design of each jetty follows the normal pattern of a jetty head of limited length (345-ft. overall in this case) carrying flow booms and pipeline manifolding as well as springing-rope bollards with isolated breasting and mooring bollards, providing a berth length of 1,050-ft., situated at a convenient distance behind the jetty head. This type of berth was chosen after examination had been made of the merits of alternative designs, including berthing beams, cylinders and monoliths, and it is of interest that, having regard to the specified design draft alongside of 50-ft. below low water of spring tides, and to the peculiar difficulties imposed by a restricted choice of berth location and working areas on site, this particular design was adopted.

The design of the fendering system takes advantage of the semi-protected nature of the Lower Hope Reach tideway and of berthing conditions, in that the energy capacity of the system is made sufficient to accommodate only one quarter of the kinetic energy of the largest vessel berthing under the worst conditions. Nevertheless a very neat and relatively inexpensive fendering system has been evolved, ease of maintenance of an entire unit being one of the major advantages.

Other points of interest in the design are the two-deck bracing system of the jetty head, powered capstans on the isolated dolphins, an impressed-current cathodic protection scheme and the berth lighting arrangements.

Having regard to the restrictions inherent in the extension of an existing installation and to the particular difficulties at this site, the construction programme must be considered to have been expeditiously completed in a total period of eighteen months for the two berths.

Discussions on Pensions for Dock Workers

The proposed meeting at the end of this month between port employers and the trade unions to discuss a pension scheme for dock workers may have a profound influence on future labour relations at United Kingdom ports.

The need for a pension scheme has been mooted for some years past, but much opposition is likely to be encountered in some quarters before anything tangible materialises.

Advocates of a pension scheme point out that about 6 per cent. of the men on the register of the National Dock Labour Board are over 65 years of age, and making retirement compulsory at 65 would substantially reduce the surplus of labour and also would increase efficiency, provided more mechanisation were introduced together with, where appropriate, an agreed reduction in the size of gangs.

Opponents of the scheme, however, are doubtful whether these arguments will find favour with many of the older men and, more particularly, whether the unions will be able to persuade their members to accept the more controversial proposals.

The discussions to be held next week are therefore vitally important and it is fortunate that labour relations have improved during recent months so that the atmosphere for negotiation is more favourable.

Pneumatic Breakwater Experiments

The pneumatic breakwater has been tried and discussed over a long period of years but accurate instrumental records of its effectiveness are not easy to come by. We therefore are glad to include in this issue the results of a full-scale trial by Professor Kurihara of Kyushu University, whose earlier experiments we published in our issue for April, 1956.

The present experiments were carried out during a typhoon in 1958 and from the measurements made then, Professor Kurihara extracts three sets of relations between wave damping and air discharge. In one of these the wave heights were estimated by eye and by calculation, for the wave height recorder was unfortunately damaged during the course of the experiment. Taking the instrumental measurements and the ocular measurements together, there is evidence that useful wave damping was achieved at an expenditure of compressed air within the range of reasonable extrapolation from model experiments recently carried out in the United Kingdom.

While Dr. Kurihara's valuable paper is welcome, the difficulty in obtaining instrumental observations of the efficiency of this type of wave calming continues. It will be of benefit to all marine civil engineers when a sufficient volume of reliable instrumental data is available about the full scale operation of the pneumatic breakwater to warrant an accurate assessment of its possibilities.

Wharfingering at the Port of Melbourne

Through the courtesy of the Melbourne Harbour Trust Commissioners we are privileged to reprint in this issue an article recently appearing in the Port of Melbourne Quarterly. We believe it will arouse considerable interest among our readers who are concerned with the efficient administration of the port transport industry in all its many facets. In the article it is explained how

the evolution of port custom at publicly-owned wharves has made it possible for the carrier's responsibility to be continued to the point where he places the goods in readiness for collection by the cargo owner. Whether similar provision is made for the reception and loading of outward cargo is not stated although there would seem to be no fundamental objection to such a course if indeed that were required.

The scheme is essentially a simple one; the carrier is given temporary possession of the wharf so that discharge and orderly delivery of the goods can be performed by him in any manner which he would be free to choose if he were the owner or lessee of the facilities provided. In most cases, particularly at "through" ports, the arrangement ensures a fuller employment of capital resources than would be possible by alternating them to specific users and directly and indirectly should lead to economies in which all user interests stand to benefit.

The Melbourne scheme would seem to offer prospects for simplifying procedures already too complicated in the traditional approach by ill-defined, or possibly wrongly defined, authority and it is in this direction that it may have its greatest appeal. A situation where it is too fatally easy to blame the other man for the shortcomings of a service should not be allowed to continue. In attempting to answer criticism of the port transport industry as it is organised in Britain can we indeed be sure that we are first asking ourselves the right question? We hope to be able to deal more fully with this subject in a subsequent issue of this Journal.

Proposed Unified Authority for the Clyde

Following protracted negotiations for the construction of a new graving dock at Greenock, it was announced last July that the Government is prepared to grant a financial loan towards the project provided a substantial part of the capital required for the scheme is raised locally. The cost of building the dock and its ancillary repair wharves and plant is estimated to total £4¼ million and the Government loan may be about £3 million.

Subsequently, at a meeting held early this month, the Clyde Navigation Trust stated that it could not offer financial help for a project outside its jurisdiction, but it would be prepared to do so if a unified port authority for the river is established with control from Glasgow to the lower reaches. This plan is similar to that suggested in the Cooper Report of 1945 and would mean that the new authority would absorb the Greenock Harbour Trust and the Clyde Lighthouses Trust.

The absence of a large graving dock has been a severe handicap to the shipbuilding and shiprepairing interests in this area and the Clyde Navigation Trust has all along supported the plan to build a dry dock and has, in fact, favoured Greenock as the most suitable site although this location is outside its control. The Trust's unification proposal was put forward in order to overcome this difficulty and also stipulated that the new port authority would be self-supporting and that users of the port ot Glasgow would not be prejudiced by uneconomic demands from any part of the unified area.

The setting up of the proposed authority which may also include other ports such as Paisley and Dumbarton, seems a practical plan which is likely to have wide support from the majority of shipping and relevant commercial interests in the area. The prospects for the ncessary legislation are considered promising.

New Deepwater Berth for the Tees

For the past fifteen years, the Tees Conservancy Commission has been working on a scheme to provide deepwater berths at Lackenby three miles from the mouth of the River Tees. Two oil berths capable of accommodating the largest tankers, were constructed shortly after the war and have been in operation for some years. Road and rail access has also been provided at the new site, which closely adjoins a large chemical factory and a new steel plant.

The scheme was part of a series of industrial developments planned at the end of the Second World War for which Parliamentary sanction was obtained. The shortage of steel, however, and more recently, Government limitation on financial credit, caused the remainder of the port improvement plan to be deferred and it was still in suspense when the time limit fixed for the start of constructional work expired. A second Act of Parliament therefore became necessary to extend the time limit from 1954 to 1964.

Although half the period of extension has passed, further hindrances have prevented any appreciable progress being made until last month, when the Chairman of the Commission announced that the first major contracts have been placed for the building of a new quay which, it is estimated, will involve a capital outlay of over £2½ million and will take 31 months to complete.

The main plan is to build a quay 3,250-ft. long at a right angle to the river channel, which will be equipped with modern cranes, cargo handling equipment and a transit shed. There will be space for five berths, two of which will become immediately operational and the others will be made available as the need arises. Initially there will be a depth of water alongside of 32-ft. L.W.O.S.T. and, if further deepening should be required, this can be carried out without difficulty. The contract for the construction of the main quay has been awarded to the Demolition and Construction Company Ltd. and a dredging contract has been placed with the Britannia Dredging Company Ltd., who have indicated a period of 40 weeks for completion. Installation of the dock equipment, transit shed, rail tracks, etc., will be carried out by the Tees Conservancy staff.

The construction of this new dock in a district where there is likely to be considerable industrial expansion during the next decade will, in the words of the Chairman of the Commission, "provide the river Tees with facilities for accommodating the larger cargo liners which are unable to use the existing Middlesbrough dock or the wharves situated further from the mouth of the river. The provision of further deepwater accommodation has become an urgent necessity in order to make the port an even more important and attractive shipping centre in future years."

Safety Film for Dock Workers

The National Dock Labour Board recently gave a preview at their Head Office of their safety film "Live and Let Live" and, at the same time, exhibited their mobile cinema.

The film shown displayed the risks and hazards faced by dock workers, and explained simple precautions that can be taken to prevent accidents. This film, like other produced for the Board, is to be shown in the various ports of the country where the Board operates. Particulars as to borrowing this and other films may be obtained from the Welfare Department, N.D.L.B., 22, Albert Embankment, London.

Association of Public Health Inspectors Conference

More than 1,800 delegates will attend the 66th Annual Conference of the Association of Public Health Inspectors, which will be held in the Winter Gardens, Margate, from 15th to 18th September, 1959. In addition, there will be representatives of a number of Government departments, overseas territories and other interested organisations.

The papers for discussion cover a wide range of subjects connected with the work of the public health inspector, and will include contributions from Port Health Authorities. A feature of this year's conference will be the Exhibition, which is the first ever to be held in conjunction with the Annual Conference and will be opened by the Minister of Health.

New Oil Jetties for Thames Haven

Details of Design and Construction

Specially Contributed

FOLLOWING the commissioning of No. 4 Jetty in 1952 Messrs. London and Thames Haven Oil Wharves, Ltd., carried out investigations into their future jetty requirements to cope with the anticipated increase in the volume of oil to be handled particularly in view of the projected expansion of Messrs. Shell Refining and Marketing Co's plant on an adjacent site. Schemes were prepared for strengthening and extending the existing jetty facilities but it became clear that with the increase in dead-weight tonnage and draught of the tankers coming into service such measures would not be sufficient in themselves.

At the end of 1955 Messrs. L. G. Mouchel and Partners were instructed to prepare estimates for two jetties, Nos. 9 and 10, each with a dredged depth of 40-ft. below Mean Low Water at Spring Tides, each capable of handling at all states of the tide tankers of 40,000 tons deadweight.

By July 1956 it had become apparent to Messrs. London and Thames Haven Oil Wharves Ltd., that they must cater for even bigger tankers and accordingly revised estimates were prepared for two jetties each with a dredged depth of 45-ft. and capable of handling tankers of 70,000 tons deadweight. This was subsequently modified to allow for tankers of 80,000 tons deadweight.

In October 1956 instructions were given to proceed with the design of the two jetties and it was estimated that a total time of two years would be required for preparing the design and contract documents, obtaining competitive tenders and constructing the two jetties.

Tenders were received in March 1957 and the contract for the Civil Engineering work was awarded to Messrs. Peter Lind and Co., Ltd., the construction time being 18 months.

Layout

The only available site for the construction of two additional deep water jetties lay at the extreme western end of Messrs. London and Thames Haven Oil Wharves Ltd. waterfront (see Fig. 1). The site was bounded at the eastern end by the existing No. 4 jetty, capable of accommodating vessels of 35,000 tons deadweight. The western boundary lay close to the Mucking flats, a large area of shallow water north of the Lower Hope Reach of the Thames.

It was clear that the proximity of these flats would cause navigational problems for the large tankers having to approach close to them and that the position and angling of the head of No. 10 jetty would be critical. The required dredging of a deep berth close to the flats gave some anxiety about the extent of maintenance dredging that might be required.

A comprehensive current survey was undertaken in the vicinity of the expected jetty positions. The Port of London Authority model of the Thames was used to study the flow patterns in the

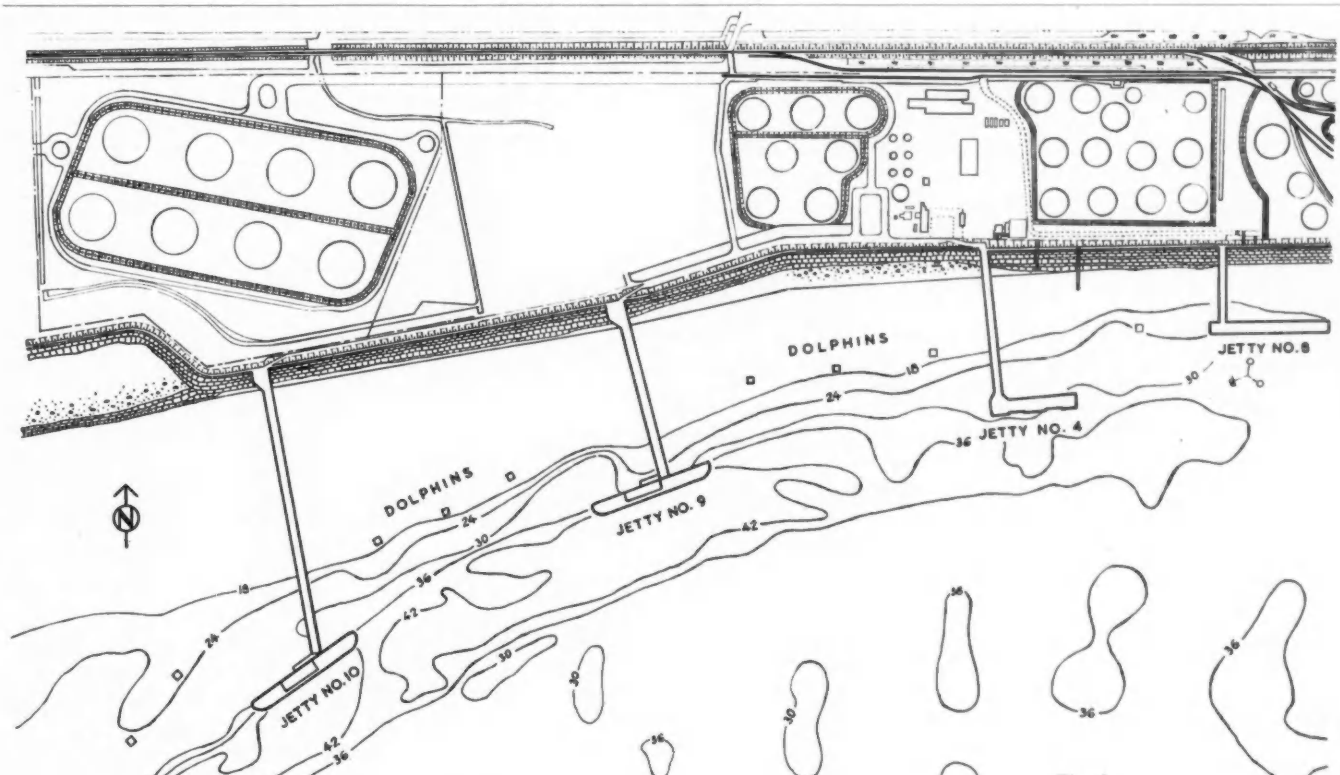


Fig. 1

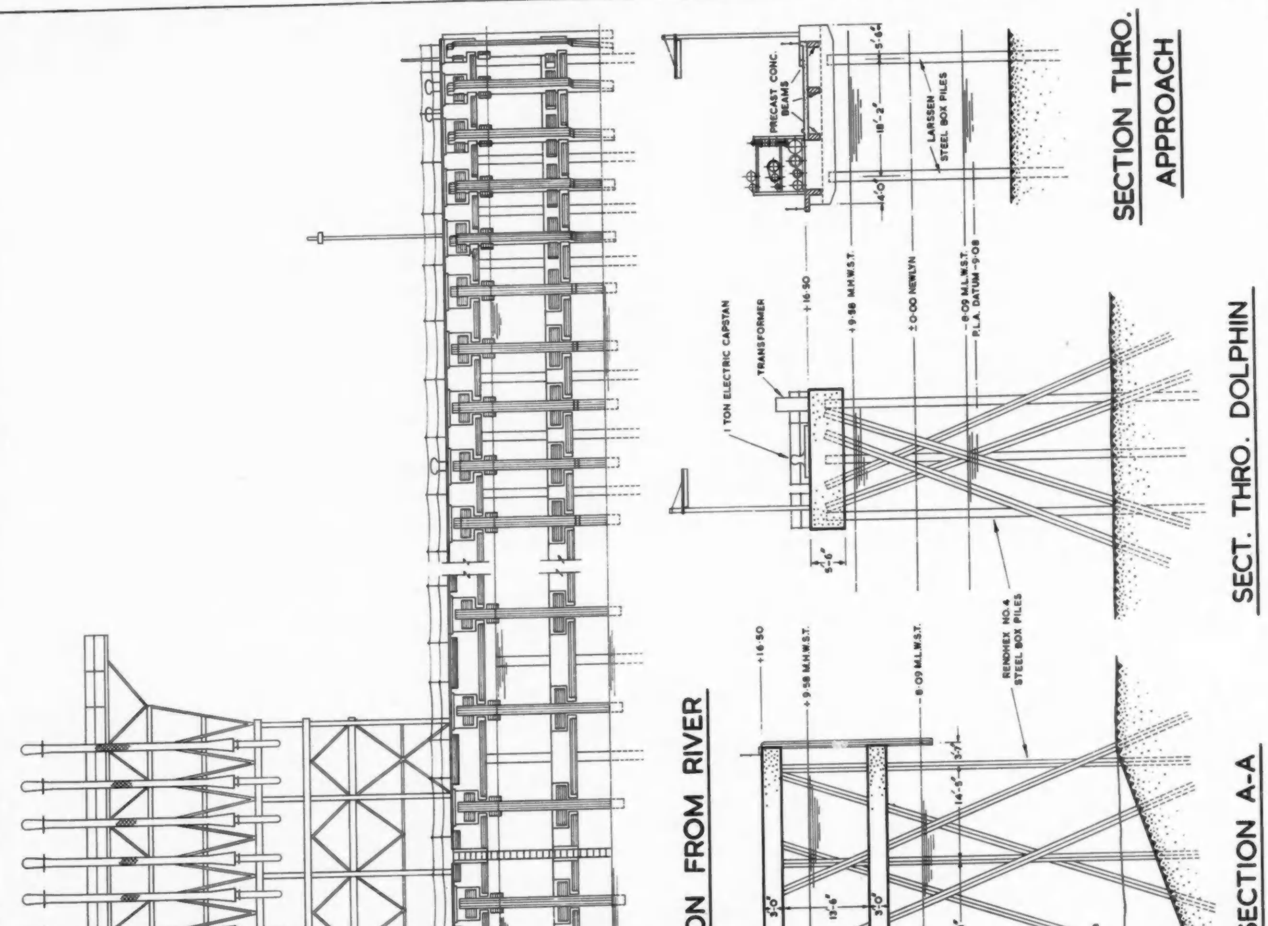

ELEVATION FROM RIVER
SECTION THRO. APPROACH
PRECAST CONC. BEAMS
LARSSEN STEEL BOX PILES
SECT. THRO. DOLPHIN
1 TON ELECTRIC CAPSTAN
TRANSFORMER
SECTION A-A
RENDHEX NO.4 STEEL BOX PILES
EXISTING RIVER BED
PART PLAN OF LOWER DECK
345'-0" O/A JETTY
40'-0"
SCALE

Fig. 2

river over various tidal conditions and to estimate the silting of the dredged areas. From these investigations the jetties were sited to the best advantage, due regard being paid to the velocity and direction of the currents at varying depths at all stages of the tide and to the necessity for avoiding interference with the use of the existing jetties, in particular the adjacent No. 4 Jetty. The centre line distances between Jetties 4, 9 and 10 being 1,050-ft.

A survey of various charts since the turn of the century revealed that several quite deep pockets had existed in the bed of the river adjacent to the site for this period virtually without change. The pockets are thought to have been formed by vessels

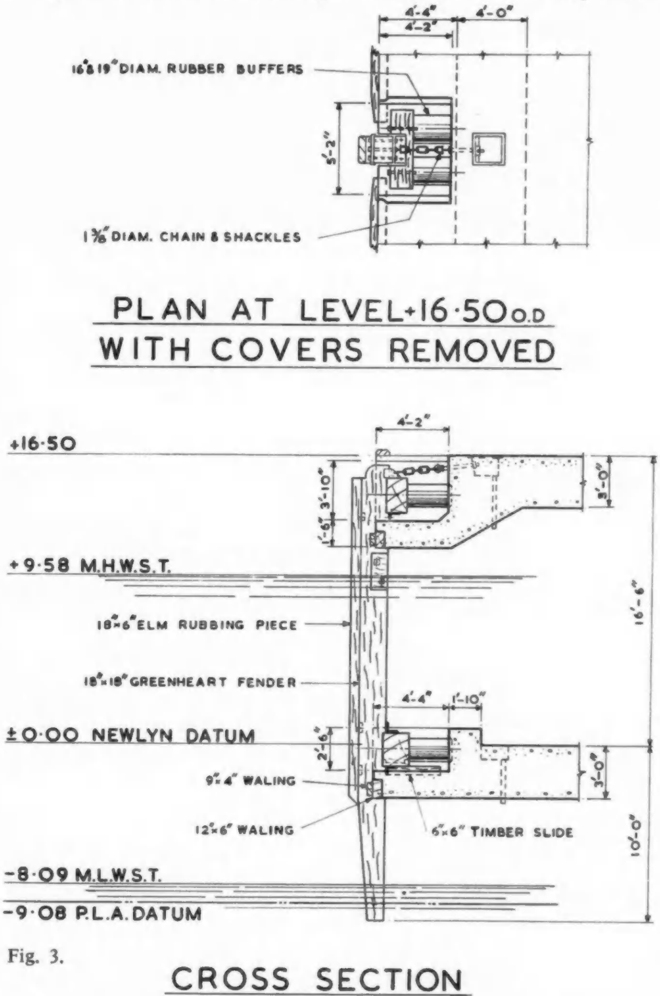


Fig. 3.

taking on ballast by use of a grab. From this and other information available it was concluded that the risk of siltation occurring in the dredged areas would be slight. In practice the dredged area has been well maintained.

Jetty Heads

The contract provided for the construction of two jetties with a dredged depth of 42-ft. below M.L.W.S.T. but provision was made in the design to allow for dredging ultimately to as much as 50-ft. below M.L.W.S.T. should this ever become necessary.

The design adopted was chosen after investigating the merits of a berthing beam system and designs based on reinforced concrete piles, on cylinders and on monoliths.

The two jetty heads are structurally identical consisting of two simple reinforced concrete slabs generally 3-ft. thick supported on a system of vertical and raking Rendhex No. 4 steel box piles (see Fig. 2). The upper deck is some 7-ft. above M.H.W.S.T. and the lower deck 8-ft. above M.L.W.S.T. The level of the bottom deck was chosen to give the lowest structural support compatible with construction being carried out between tides.

The jetty heads are designed to withstand the forces transmitted by the fendering system described below. The supporting piles consist of 80 vertical piles, 12 raking piles driven parallel to the jetty axis at a rake of 1 to 2½ and 48 raking piles driven at right angles to the jetty axis 24 at 1 to 2½ and 24 at 1 to 3. The lateral raking piles are sited at the extremities of the structure and the longitudinal ones in the centre. The vertical piles are on average 105-ft. long and carry a working load of 80 tons whilst the raking piles are 115-ft. long and carry loads up to 95 tons.

The lengths of piles used were chosen after trial driving had revealed that the piles would have to be considerably longer than had been expected from the soil investigation. This had indicated that the piles could be driven to the required set in the dense gravel whereas in fact the piles penetrated to the underlying Thanet sands.

The first piles were despatched to the site in one piece of the full length required. To meet the required programme it was however found necessary, due to fabrication and transport difficulties, to accept the piles in shorter lengths and to weld on site. After experiment it was decided to adopt a simple butt joint without any other means of strengthening but to insist on a very rigid specification including the testing of every joint with gamma ray equipment.

After welding the piles were grit-blasted, primed and painted using two coats of a bituminous enamel. In order to ensure freedom from dampness and to assist drying of the coats the piles were internally heated by steam.

The driven piles were hearted with concrete after any water standing in the piles had been removed.

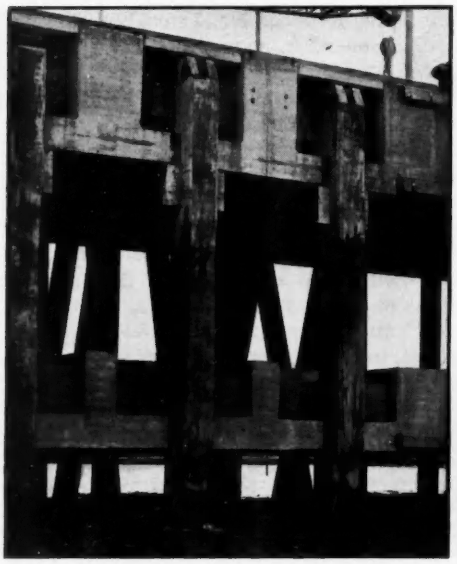
Design of Fender System

In designing a free standing jetty with the top deck some 70-ft. above the ultimate dredged level the design of the fendering system was naturally of the greatest importance since it was essential to absorb in the fendering system a considerable proportion of the kinetic energy of the berthing tanker in order to avoid damage to the tanker and to reduce to a reasonable amount the energy to be absorbed by the structure itself.

The basis of design adopted was that the fendering should be capable of absorbing 2,800 inch-tons of kinetic energy, this being the 25% of the energy of a vessel of 45,000 tons deadweight (60,000 tons displacement) approaching the jetty normally with a velocity of one foot per second. This figure was chosen after consideration of the degree of exposure of the site and the tidal flows and after consultation with the operators of similar installations. Experience at the site had shown that larger vessels were handled with additional care and it was thought that to provide for a larger energy absorbing capacity would not be economic.

The design of fendering chosen consists of 18-in. x 18-in. vertical greenheart fenders faced with elm rubbing strips. Each fender is supported laterally on two substantial greenheart cross heads, one at the level of the top deck and the other at the lower deck. Between each cross head and the concrete decks are two solid rubber cylinders which when compressed are capable of absorbing their share of the energy (see Fig. 3).

The fender is held to the jetty by two chains, one at each deck level, which when installed are tensioned to give a precompression of the rubber cylinders of 1-in. The fenders are held in position longitudinally by mild steel locating jaws cast into the decks, the weight of the fender unit is carried by greenheart sliders at bottom deck level.



Front view of fendering system at Jetty head.

Pile frame mounted on pontoon driving raking piles in jetty head.

Top deck of Jetty No. 9 under construction.

The extremities of the jetty head are curved to ensure that skew blows are always resisted by more than one fender unit. Since all tankers using the jetties will be considerably longer than the head, the majority of the berthing forces will be taken by the end fenders, and these have been closer spaced and have larger rubber buffers than the central ones. There are 18 units having 24-in. x 16-in. dia. buffers and 12 units having 29-in. x 19-in. dia. buffers. The maximum travel of the units is 14-in.

The fender units have the advantage that they can be prefabricated complete, lowered into position by means of a mobile crane, and erected or replaced as necessary with the minimum of delay to shipping.

Whilst the jetties have only been in commission a short time, the fenders appear to be working efficiently and tanker captains consider them favourably.

Design of Approach Jetties

For speed of construction the approach spans were designed of precast reinforced concrete in standard bays supported on pile bents at 30-ft. centres. The piles are Larssen steel box piles on which insitu reinforced concrete cross beams were cast in position to receive the precast reinforced concrete longitudinal beams. The deck forming the roadway was cast insitu to stiffen the whole structure; no deck is provided under the pipe runs in order to simplify maintenance of the pipes.

The approach of No. 9 jetty is 474-ft. long and No. 10, 774-ft. long. Gaps are provided between the jetty heads and the approaches to prevent the effects of berthing forces being transmitted to the approaches.

Dolphins

The seven mooring dolphins included in the contract consist of a heavy concrete slab 21-ft. x 27-ft. x 5-ft. 6-in. thick supported on 5 vertical and 11 raking Rendhex No. 4 steel box piles, the raking piles being driven both parallel and at right angles to the line of the river. The dolphins are designed to withstand a bollard pull of 150 tons.

Jetty Facilities

Each jetty head is equipped with a "Flowboom" hose handling equipment manufactured by the Woodfield Hoist and Associated Industries Ltd. Each unit consists of four 12-in. and four 8-in. flowbooms which are designed to be capable of coupling up to the manifolds of any tanker likely to use the berths. The "Flowbooms" are connected to an extensive manifold mounted on a reinforced cantilever platform protruding from the rear of the top deck. From the manifolding sixteen pipes varying from 24-in. to 6-in. in diameter extend the full length of the jetty approaches and are designed to deal with any of the oil products which are handled on the jetty. The pipework was fabricated and erected by William Press and Son Ltd.

Cathodic Protection

In addition to the protection provided by bituminous enamel all the steel piles forming the supports of the various structures are connected to a system of cathodic protection. The system used is the impressed current one, each jetty and approach being supplied from a common transformer rectifier unit, whilst each dolphin is fed from a small unit transformer rectifier mounted on the dolphin.

Construction Programme

After consideration of the limited construction period of 18 months for the civil engineering works, and of the arrangement of the raking piles in the jetty heads and dolphins, Messrs. Peter Lind and Co. Ltd., decided to transport and drive all piles by floating plant. Independent access thus obtained permitted the construction of the approach superstructures to proceed unhindered.

Priority in the programme was given to the completion of Jetty No. 9, with the ancillary dredging and dolphins. After the completion by Messrs. London and Thames Haven Oil Wharves Ltd., of the pipelines and "Flowboom system," it would thus be possible to place the first jetty in commission at the earliest possible time.

Dredging

The dredging, amounting in all to 237,000 cu. yds., was sublet to the Tilbury Contracting and Dredging Co. Ltd., and executed in two separate phases. The first phase, carried out soon after the start of the contract, comprised the dredging of 37,000 cu. yds. in the area of the two new jetty heads. The second phase

commenced some 10 months later, and proceeded at an average of 6,500 cu. yds. per week, causing the least possible interference with the other operations on the jetties and dolphins.

Working Area on Land

While the first phase of dredging was in progress, preparations were in hand for the working area on land and the floating piling plant.

The working area was situated about 100-ft. behind the river embankment wall and it was separated therefrom by an access road and new elevated pipelines.

Sufficient area was required for the unloading, stacking, cleaning and painting of the steel box piles, for the storage of reinforcement, for the layout of the concreting plant for the works, and for the fabrication of the precast approach beams and of the large timber fender units. A 10-ton electric self-propelled derrick was provided to cover the maximum possible area and to supply all heavy materials to a second 10-ton electric fixed derrick, mounted on the river embankment on bored pile foundations. This second derrick could feed into floating plant moored alongside a temporary timber pile jetty with sufficient water above half tide for barges and pontoons.

The concreting plant comprised two 21/14 mixers with weigh batching and bulk cement facilities and was capable of an output of 17 to 20 cu. yds. per hour.

As noted previously, the test piles disclosed that the No. 3 and No. 5 Larssen steel box piles for the approaches and the Rendhex box piles for the heads would require to be at least 20% longer than originally contemplated. These alterations necessitated considerable re-organisation of the working area to provide an adequate number of long welding beds for lengthening the piles, and to provide increased stacking area. The pile driving operations were delayed about five weeks by the alterations in requirements.

The major part of the welding of the Rendhex piles to a very strict specification was carried out as a subcontract by The British Arc Welding Co. Ltd.

Pile Driving

The driving of the steel box piles was executed by a single acting steam hammer of effective weight of 4 tons operating on a Menck and Hambrock MR40 piling frame carried initially by a pontoon 100-ft. long, 40-ft. beam, and 500 tons deadweight.

This pontoon also carried a 6-ton steam crane. It was moored by double head and stern wires and two breast wires on each side. The use of steam winches up to 10 tons in capacity gave ease of movement and precise control during piling operations.

By mounting the pile frame on an undercarriage of steel joists 1 metre deep spanning transversely across the stern of the pontoon, it was possible to drive both vertical and raking piles on either side or over the stern. Special provision was made to jack up and to fasten down the pile frame after each transverse or rotating movement, thus converting it to a fixed frame, a very necessary requirement for operation in an exposed position subject to considerable wind and wave action and the wash from passing ships.

The available headroom of over 80-ft. under the hammer down to water level was of great assistance in dealing with the 115-ft. long piles, reducing delays at low water to a minimum. The driving of the raking piles in the heads and the vertical and raking piles in the dolphins, the latter to a complicated pattern, was greatly facilitated by the ability to move the piling plant on the pontoon.

The steel piles were ferried out from the shore on a 100-ft. steel barge towed by a 90 h.p. launch.

After completion of test piling and the lengthening of the piles, pile driving in No. 9 approach proceeded at an average daily rate of 3 piles 92-ft. to 99-ft. long, the maximum number in any one day being 5.

Driving of the longer piles in the heads continued at an average rate of 2 to 3 per day, dependent on the weather and the proportion of vertical and raking piles. The maximum number driven in any one day was 7.

As driving proceeded, a barge carrying a 5-ton crane with 55-ft. jib was used to place temporary timber transverse and longitudinal bracing to the piles at a single level intermediate between the two decks. Diagonal bracing in plan was provided by wire ties.

The position of these jetties at the eastern end of Long Hope Reach is very exposed and during the very heavy gale of November 4th 1957, the piling pontoon sank. Salvage operations and the provision of a replacement piling plant proceeded concurrently, and a similar pile frame mounted in a similar manner on a pontoon 125-ft. long and 60-ft. beam was at work within 6 weeks of the accident.

Concreting of lower deck of Jetty No. 9 in progress.

It was found more convenient to omit the longitudinal raking piles at the centre of each jetty until the concrete decks had been cast.

These piles were then pitched through temporary holes in the decks by the Menck and Hambrock pile frame working as a heavy crane. The piles were driven by a 10B3 McKiernan Terry steam hammer suspended from the pile frame. After driving, the temporary holes were made good.

Reinforced Concrete Approaches

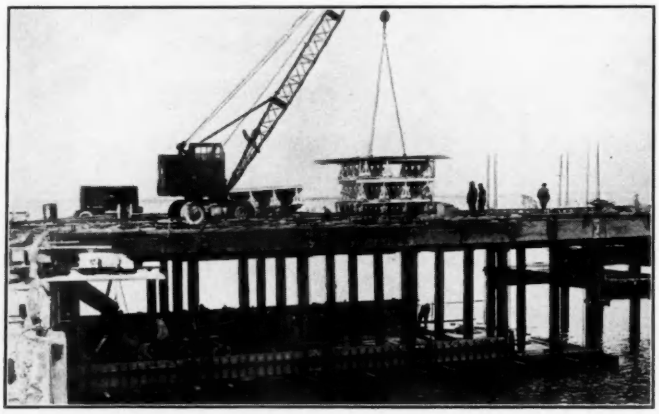
As the piling in the head proceeded, construction of the approach was put in hand. After the fixing of temporary horizontal bracing, prefabricated transverse beam shutters were placed by a second crane barge of 7-ton lifting capacity. When the lower half of the beam was sufficiently mature, the longitudinal precast beams up to 6 tons in weight were placed by the same craft and the remainder of the transverse beam was cast monolithically with the deck.

Reinforced Concrete Decks in Jetty Heads

The soffite of the lower deck was 2-ft. 4-in. and 5-ft. above mean low water neaps and springs respectively. The time avail-

able for constructing and later striking the formwork, even in calm weather, was therefore very limited.

Consideration of these facts influenced the decision to construct the upper deck first on formwork supported on heavy 18-in. x 7-in. joists spanning transversely the full width of the jetty. The ends of these joists were supported by longitudinal joists, which in turn were suspended from the outer vertical piles by high tensile steel rods. Due to the substantial thickening of the upper deck at the jetty face to accommodate the fenders and their fixings, additional timber trestling above the joists was required to support the remainder of the deck.



Lower deck of Jetty No. 9 under construction.

After the upper deck had matured the pile bracing was removed, the soffite shutters were lowered to a convenient height, and the shuttering was altered to suit the lower deck. The form was then lowered at low tide to its correct level for this deck and secured to the vertical piles to reduce the effect of wave action.

When the lower deck had been cast, the shutter was again lowered and the joists were pulled out transversely by one of the crane barges.

The construction of the decks commenced at the junction with the approaches, partly for reasons of access for men and materials, partly to obtain the maximum temporary transverse support until a length of upper deck had been cast.

The concrete to the heads was carried out in pours of 65 cu. yds. and 33 cu. yds. for the upper and lower decks respectively. The size of pour on the lower deck was governed by the time available at low tides which averaged about 4 hours, half of this time being occupied in final cleaning prior to pouring and in finishing and protecting with steel shutters the upper surface of the concrete. Due to the precautions taken, only minor damage due to waves was caused to the deck surface. However, on several occasions, forms in course of preparation were damaged by rough weather, on other occasions it was not possible to work effectively due to difficult conditions. Although considerable overtime and night work was operated, it was not found possible to reduce the period of 5 months between the first concrete pour on the upper deck and the last concrete pour on the lower deck in the same jetty head.

The total concrete in the two heads was 6,500 cu. yds. of which 3,000 cu. yds. were placed in the lower decks.

The concrete for the No. 9 jetty was transported by monorail, and that for No. 10 jetty by dumpers and lorries. In both cases the concrete for the lower deck was deposited through elephant trunking in temporary holes in the upper deck.

Dolphins

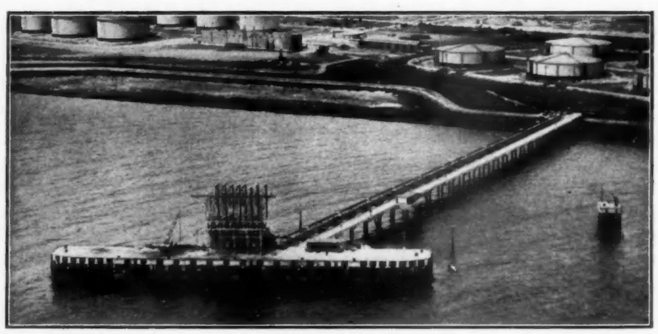
The formwork for the soffite to the concrete slab was suspended from the four vertical corner piles and was designed to support an initial pour of one third of the total height of 5-ft. 6-in. The external forms were erected for the full height.

The concrete was placed in 3 separate pours of 45 to 50 cu. yds each. It was transported in 1 cu. yd. skips from the concreting plant by lorry to the shore derrick and thence by barge and tug to a crane barge moored adjacent to the dolphin. The first pour was allowed to harden for 5 days before the second pour was placed.

The Lighting System

Consideration was given to alternative methods of lighting the jetties and approach roads. Because of the explosive hazard, certified flameproof fittings were essential, and the choice lay between flameproof floodlights fixed on the loading gantry, or flameproof fluorescent fittings mounted locally. The floodlighting method was abandoned because of interference with navigation on such a busy seaway. In addition, there was a limitation in distribution and shadows etc. coupled with the possibility of glare. Moreover, the use of tungsten lamps with only a 1,000 hours life, would have greatly increased the maintenance costs. The scheme finally adopted consisted of tubular steel poles 20-ft. high, supporting an angle iron frame carrying 3 G.E.C. Cat. No. F.65805 5-ft., 80-watt flameproof fittings. The fittings are equipped with a special PVC reflector which after wide experience in practice, has been found to be much more durable in exposed positions than specially treated steel reflectors. The end boxes of the fittings are so arranged that disconnection and tube replacement can be carried out from the column end of the fitting. There are columns mounted 60-ft. apart on one side of each approach road, and further columns on the jettyheads. The average illumination on the horizontal working plane at ground level is 2-3 lumens/sq.ft. The distribution is good, and on the jettyheads the edges of the platform are well defined. Additional single fittings are employed over the motorised equipment on the loading gantries, and the total number of G.E.C. fluorescent fittings in the complete installation is 200.

Each installation is supplied from a 3.3 KV, 3-phase/415-v., 3-phase four wire Delta/Star connected transformer. This transformer is housed in the sub-station on the approach road,



Aerial view of Jetty No. 10, nearing completion.

together with the cathodic protection equipment. Special G.E.C. Flush Cubicle type Control Boards house the main switchgear, meters and ancillary equipment etc. The wiring from the substation to the lighting columns is in PVC SWA cables, and G.E.C. flameproof/weatherproof junction boxes are fixed at the base of each column. The lighting installation is controlled by means of a time switch and manual switches fixed in the small office on the jetty head. The time switch automatically switches on half the fittings at dusk, and the remainder is on manual control.


DREDGING SPECIALISTS
Tilbury Contracting
& Dredging Co Ltd
59a London Wall,
London, E.C.2.

Lighting at one of the jetty heads.

Lighting of one of the Jetty Approaches.

The electric lighting and power installations for both jetties were designed and installed by the electrical staff of London and Thames Haven Oil Wharves Ltd. under the Chief Electrical Engineer, Mr. L. T. Lewis and the Assistant Chief Electrical Engineer, Mr. K. Irving.

Conclusion

The working area was made available in mid April 1957. Despite the delays mentioned, the civil engineering works in Jetties Nos. 9 and 10 were virtually completed at the end of July 1958 and end of December 1958 respectively.

After completion of the oil pipework and the "Flowboom" the first tanker was berthed at Jetty No. 9 on the 20th December, 1958.

The preliminary investigations, design and supervision of construction of the jetties were carried out by Messrs. L. G. Mouchel and Partners who retained Messrs. Spenser and Partners to design the cathodic protection system.

The installations of the pipelines, manifolds and "Flowboom" system were carried out under the supervision of Messrs. London and Thames Haven Oil Wharves Ltd.'s Chief Engineer, Mr. J. W. Kittle, A.M.I.Mech.E.

Litigation in the Port Industry

Two Recent Cases of Interest

By LAURENCE WEBLEY, LL.B.

Fencing the Berthing Edge of a Wharf

Two questions of general interest to wharf occupiers were discussed recently in the Queen's Bench Division of the High Court in a case where a Polish carpenter claimed damages for personal injuries against a firm occupying a wharf in the Port of London, Wilczek v. Gardiner & Tidy, Ltd.

The circumstances which gave rise to the claim were somewhat unusual. The plaintiff was working for John Mowlem & Co. Ltd. of London. In 1956, when the accident happened, this firm was engaged in repairing two dolphins to which Cherry Garden pier in Bermondsey was moored. The work involved "re-scarping" and the use and handling of large baulks of timber. Mowlem & Co. had found it necessary to moor a pontoon to the dolphins to carry the workers' huts, a derrick crane and some very large large timbers. Unfortunately, on the 15th January, 1956, the whole contraption tipped up and sank so that the contractors were faced with the necessity of finding a temporary site for their work until they could replace the pontoon. They were able to make an arrangement with Gardiner & Tidy, Ltd. to put up their huts on the concrete bank at the back of the Cherry Garden wharf and work on their timbers there. It was stipulated that this arrangement should not interfere with the busy work of the wharf and that the contractors would be responsible for any untoward event.

The wharf manager also agreed that the contractors might use his crane on the wharf to lift their heavy timbers out of the river, where they had been rafted after the sinking of the pontoon, and put them back in again after shaping. This was subject to the crane driver having the time, and no charge was made; there were, in fact, only 14 large timbers. Otherwise the contractors were charged £1 per week for the use of the wharf.

Following this arrangement Mowlem & Co. recommenced work and from time to time the plaintiff would act as a slinger when the large timbers were moved by the crane or help move the smaller pieces onto or from the wharf. Work started about 8 a.m. The crane driver arrived about 7 a.m. to light the fire box in his crane so that steam would be up by 8 a.m. when the crane started operations.

In February the weather became very cold and the custom was that the first of the contractors' men to arrive lighted a fire in their hut to dry out their working clothing and their tools, as they believed the latter might break if used in a very cold state. It was found convenient to obtain a shovelful of live coals from the crane fire to start this fire going. On the occasion in question Wilczek had gone to the crane to get the coals. It was a very cold morning with snow, ice and frost. The crane driver had left the cab to get his breakfast so Wilczek climbed in and filled his shovel from the fire box. In climbing down to the ground he slipped and fell over the edge of the wharf to the foreshore fourteen feet below. He was seriously injured.

In making his claim for damages he alleged that the defendant wharf occupiers were negligent because they had allowed water to drain from the crane and form a patch of ice on which he must have slipped.

He also declared they had broken the Docks Regulations 1934; regulation 1 because they had not properly maintained the part where he slipped and 1(a) because they had not fenced the edge

of the wharf. The wharf was about 120 feet long and 38 feet wide. There was a low dwarf wall or kerb about a foot high along the berthing edge. The crane concerned was at the west end and mounted on rails about 2 ft. 7 ins. from the dwarf wall. It was from this narrow space that the plaintiff fell.

His Lordship first dismissed the claim at Common Law saying he was not satisfied about the patch of ice. Even if the plaintiff was "invited" to be on the wharf he was not "invited" to climb onto the defendants' crane and help himself to their coals.

Turning to the Docks Regulations, Regulation 1(a) said "in particular the following parts shall as far as is practicable, having regard to the traffic and working, be securely fenced . . . all breaks, dangerous corners and other dangerous parts or edges of a dock, wharf or quay". His Lordship said in his opinion the word "dangerous" qualified "edges" as well as "parts". He agreed with the argument that a berthing edge was not dangerous to a person handling goods on a dock, wharf or quay because it was obvious and could be avoided. Nor, to his mind, was it practicable to fence it. If there was a wall or fence in position while the main dock operations were in progress the dock workers would be impeded and it would be likely to cause accidents. Slings or posts might catch in it or be upset. The dwarf wall, it was said, was worse than nothing because it could catch a man's leg below the knee and cause him to fall over. The object of the dwarf wall, however, was probably to stop goods falling over the edge. That in itself was a safety factor because it protected people unloading from a low barge alongside the wharf. It would also act as a kerb to mark the edge and prevent people stepping too far out. He thought, on balance, the dwarf wall was conducive to safety rather than danger. A fence would have to be moved out of the way when the processes were being carried on and could only be in position when they were not and could, therefore, have no effect.

The first part of the Docks Regulations had also been pleaded "Every regular approach over a dock, wharf or quay which persons employed have to use for going to or from a working place at which the processes are carried on . . . shall be maintained with due regard to the safety of the persons employed." His Lordship said he agreed the plaintiff was employed in the processes on the few occasions when he helped to load or unload timber on the wharf but he was not doing any of these things at the time of the accident. His unauthorised expedition could not be regarded as ancillary to the infrequent and minor operations mentioned. The place of the accident was not a regular approach or working place for the plaintiff. In any case the defendants had not failed to "maintain" the dock. Everyone must sympathize with the plaintiff but he had no valid complaint against the defendants.

It seems, therefore, that a berthing edge is probably not among the "dangerous edges" mentioned in the Regulations and, in any case, the court does not regard it as practicable to fence such an edge in any way. This is important perhaps not so much in the case of regular dock workers but where casual visitors or persons unfamiliar with the conditions are concerned.

Clearing of "Spillage" in a Hold

Another regulation, 11 (1) of the Docks Regulations which provides that where a hold is over five feet deep "there shall be maintained safe means of access from the deck to the hold in which work is being carried on", was considered in Mace v. Green & Silley Weir Ltd. and Another (a shipowner). The plaintiff, Mace, had been sent to open man hole covers in the hold of the steamship "Kenya" belonging to the British India Steam Navigation Company lying in wet dock at the Royal Albert Docks and unloading cargo.

Coming out of the hold the plaintiff fell off a ladder because of a piece of rope wound round it. He was seriously hurt. He sued both his employers and the shipowners declaring that the latter were in breach of Regulation 11 (1). The cargo in the hold in question had been unloaded and the main deck hatch covers replaced but work was still uncompleted in that the spillage in the hold had to be swept up.

After declaring that, in the circumstances, the first defendants, Mace's employers, were not to blame his Lordship considered the case against the second defendants, the ship owners. Regulation 11, he said, was perfectly general and not limited to persons employed in the processes. The question was whether it applied in this case where the actual unloading of the bags and cargo had been completed from this particular hold though unloading was going on in other parts of the ship. He accepted the argument that the words, "in which work is being carried on" must mean work in the processes. But it was said that work was still going on as there were still "goods" in the hold, namely the spillage. There was, apparently, no authority on this point. It had been held in other cases that the closing of the main deck hatch covers was part of the process of loading or unloading. But his Lordship did not take this as meaning that replacement of the hatch covers was conclusive evidence of the completion of loading or unloading. It seemed to him the clearing up of spillage was ancillary to the unloading process. Accordingly, the Docks Regulations applied and as there was not a safe means of access from the lower hold the shipowner was liable.

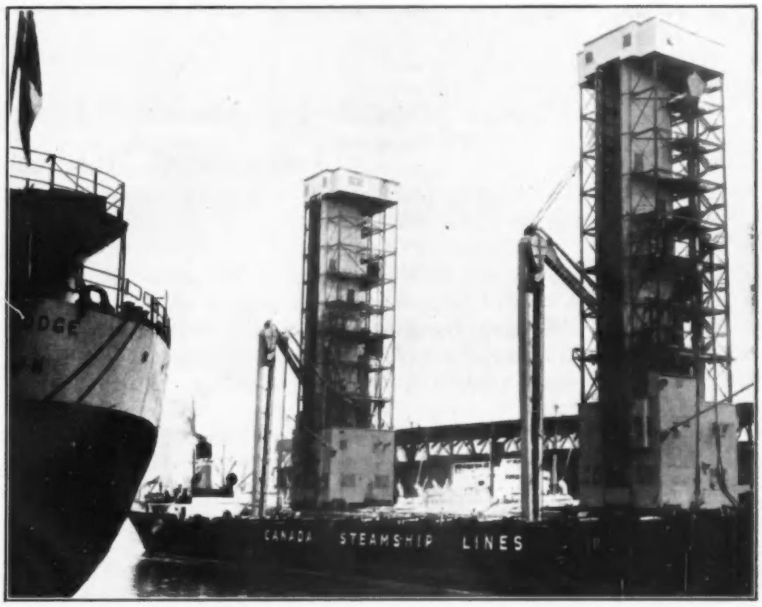
Pneumatic Ship Discharging Plants at Montreal and Quebec

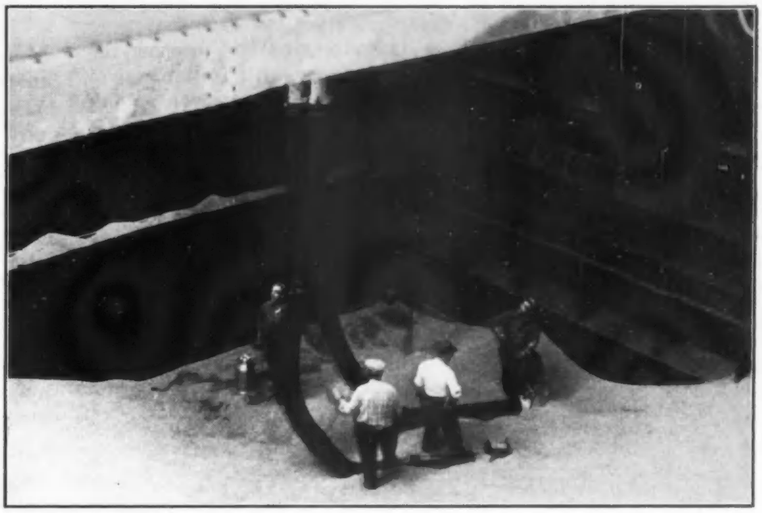
New Equipment to Expedite Grain Handling

The construction of the St. Lawrence Seaway has brought about major changes in the transport of bulk grain to the Eastern Ports of Canada. Hitherto the only grain carrying vessels reaching Montreal and Quebec have been Canallers 250 feet long, 44 feet beam, carrying 100,000 bushels of grain, but the opening of the Seaway allows passage to the large Upper Lakers 720 feet long, 69 feet beam, carrying 800,000 bushels.

To unload the grain at Montreal and Quebec the National Harbours Board has ordered 8 special plants which are unique in that they incorporate not only the familiar belt-and-bucket elevator "marine leg" system to dredge grain out of the hold but also pneumatic suction equipment. This is the first time that this pneumatic ship discharging technique has ever been used on a major scale in the North American grain trade. The pneumatic discharging plants, all of which will come into service during the 1959 season, have been designed and engineered by Simon Handling Engineers Ltd., Stockport, England, and are being supplied through their Canadian subsidiary, Simon Engineering Companies of Canada Ltd., Montreal.

Each suction plant is mounted alongside an orthodox marine leg on a steel tower which can move on rails along the jetty and is placed opposite the hold to be unloaded. The marine leg is lowered into the hold where the buckets scoop up the grain, elevate it and discharge it through a chute on to a belt conveyor along the jetty. The marine leg can only maintain full capacity while working in sufficient depth of grain to fill the buckets completely. Once it has dredged down to the bottom of the hold, it can only be kept at work if the grain still remaining banked up around it is fed to the buckets by power shovels, and during this





Above: View of the mechanical marine leg and the two pneumatic suction pipes belonging to one of the two installations. Top Right: The two combined mechanical and pneumatic grain discharging installations already in service in Montreal. Bottom Right: Showing the shallow depth of grain in which the suction nozzles of the pneumatic plant are able to operate.

trimming operation the marine leg's capacity drops so sharply that the *average* rate of unloading a complete hold is far below the rated maximum capacity of the leg.

Each suction plant has two pipe booms projecting over the hold and to each of these booms is attached a vertical telescopic pipe terminating in lengths of flexible piping with suction nozzles at their ends; air is drawn in through the nozzles and piping by powerful vacuum pumps, and the grain is sucked up and discharged through vacuum seals on to the same jetty conveyor that receives grain from the marine leg. The nozzles on their flexible piping can be easily manhandled into every corner of the hold, and can suck out grain which the marine leg cannot reach; moreover the nozzles can maintain full capacity in far less depth of grain than is needed to keep the marine leg fully fed.

By operating the marine leg and suction plant simultaneously, full unloading capacity is maintained until the hold is practically empty: no power shovels are needed, and only during the last minutes of unloading is a little light hand-shovelling required to feed the last of the grain to the suction nozzles. Thus the average rate of discharging a complete hold is not far short of the maximum rated capacity of the marine leg and suction plant combined.

The two plants already in service at Montreal have each a rated maximum capacity of 27,000 bushels per hour. If this capacity were provided by the marine leg only, the average discharging rate of a complete hold would be about 15,000 bushels per hour (55 per cent. of rated maximum) and 17 men would be needed to operate power shovels. With marine leg and suction plant working together, the average discharging rate is about 22,000 bushels per hour (over 80 per cent. of rated maximum) and only 9 men are needed. These figures indicate that the average discharging rate achieved by the combination of marine leg and pneumatic suction equipment is 47 per cent. higher than the rate achieved by a marine leg only. Moreover, by the elimination of the need for power shovelling, the increase is achieved with a 40 per cent. reduction in manpower.

Increasing Trade of the Dominican Republic

The cultivation of cotton in the Dominican Republic is becoming of increasing importance and it is hoped to commence shortly the export of high quality raw cotton. To this end, equipment for a new method of bulk loading for raw cotton has recently been installed at the Republic's ports of Luperon, Puerto Bello and Ciudad Trujillo by the firm Consorcio Algodonero Dominicano. This will enable the transport of cotton by sea, from the plantations to the mills of the company at Ciudad Trujillo, with a minimum of handling and without the necessity for baling. The largest of these installations at the new port of Luperon consists of a 1,000 yard long suction tube mounted on a jetty.

Materials Handling and Ships

Papers presented at the First International Conference of the Institute of Materials Handling

THIS Conference was held in London in May last. Lectures were divided into four groups, one of which was entitled "Materials Handling and Ships." There were six works' visits and they, too, had a maritime flavour, since one party spent two hours inspecting mechanical handling methods at the London Docks.

The main theme running through the three lectures on "Materials Handling and Ships" was the need for more unification in every aspect of size and measurement concerned with loading, unloading and palletisation. One of the papers was read by a Frenchman (Mr. A. Vincenti) and another by a Scotsman (Mr. R. C. Somerville). The third was presented by Mr. K. Plutynski and Mr. E. Obertynski of Poland.

It is interesting to compare the three papers. Sometimes they overlap, sometimes they are complementary but each leaves no doubt that the port industry in many countries is meeting the same difficulties and trying to solve them with initiative and enterprise. The fork lift truck and the pallet are given an important place in each paper and each lecturer emphasises that progress in materials handling methods in ports cannot be made by the efforts of port operating organisations alone. Shipbuilders, shipowners, machine manufacturers, port authorities and trades unions are some of the other bodies vitally concerned. Two of the lecturers placed great emphasis on the training of port operating personnel.

Extracts of the three papers follow:

Modern Methods of Handling Miscellaneous Goods in Ports

by A. Vincenti

The constantly increasing capital and operating costs of ships make it imperative to reduce to a minimum the time during which they are immobilised and consequently unproductive.

The most important factor in the turnround time of ships is, without question, the time spent in unloading and reloading in ports. It follows, therefore, that if these operations can be accelerated a vessel should be able to perform more round trips in a given time.

Today's port delays of which shipowners complain are in general due to the insufficient emphasis which has in the past been given to mechanising the handling of miscellaneous cargoes; it is in this class of work that the introduction of rational mechanical handling devices can produce important progress.

I propose to devote this paper to modern methods of this type now under development in Western European ports.

ANALYSIS OF HANDLING OPERATIONS IN SHIPPING

Discharging Ships

Discharging a ship is divided into three operations:

1. Breaking down the stow in the hold.
2. Bringing the goods into the square of the hatch and hoisting them.
3. Setting them down on the quayside or in transit shed and later loading them into road or rail vehicles or into lighters.

Loading Ships

For loading the same three sections are in reverse, namely:

1. Placing the goods under the hook of the hoisting gear, either from within a transit shed or directly from the means of shore transport or lighter.
2. Hoisting and placing in the hold.
3. Stowage in the hold.

Ancillary Operations

1. Unloading rail vehicles and lorries bringing to the port goods for the ships and loading the same vehicles with traffic coming out of the ships.
2. Stacking goods awaiting shipment or delivery in the hinterland.
3. The work of sorting, weighing and sampling goods.

CLASSIC METHODS OF PERFORMING THESE OPERATIONS

Stowing and Unstowing within the Hold

These operations are carried out by hand by hold gangs without using any mechanical aid except in the case of packages too heavy to be handled and for which some mechanical device however rudimentary is essential.

The work is arduous: for unstowing, the goods must be taken out of stow and moved horizontally under the square of the hatch which can be a long distance in a ship with large holds. For stowing, the goods must be carried horizontally in the reverse direction from under the square of the hatch to the place of stowage for the voyage. These movements are not easy. They are tiring and towards the end of the day the work becomes slower. The operations are also not without danger and risk of damage to the goods.

Shore Operations

Placing the goods on the quay or bringing them alongside for loading is still often carried out by shore gangs without the assistance of mechanical handling devices; for packages with a weight not exceeding 80 kgs. the goods are carried and for heavier packages they are either rolled or handled by means of dollies or hand trucks. Only the very heaviest packages are transported by mechanical means, either lorries, railway trucks or mobile cranes.

For traffic which has to be held in transit shed between unloading and delivery or arrival at the port and loading, these manual operations are particularly arduous as the goods have to be stacked in the sheds.

Ancillary Operations

Like quayside operations, these are carried out by hand with some lifting devices for heavy packages or elevating conveyors for piling bags or small packages and loading them in lorry or wagon.

For the heaviest packages mobile cranes or similar lifting devices are necessary for loading and unloading the means of transport on land.

MODERN METHODS OF HANDLING

We will now consider the processes already mentioned in the light of the employment of modern mechanical handling devices in three sections:

1. Hoisting, placing in the hold or on quayside.

2. Handling on land including ancillary operations.
3. Handling on board (stowage and unstowage).

Hoisting, Placing in the Hold or on the Quay

No significant changes have taken place in recent years: either quayside cranes or ship's handling gear are normally employed. There is, however, a tendency to increase the capacity of quayside cranes. Whilst before the war normally capacity did not exceed 30 cwts., those recently placed in service are rarely below 3 tons and there are many with capacities of 5 tons or more.

Handling appliances on board ship have also been much improved and on a number of new vessels, ships' derricks have been replaced by either fixed or mobile cranes.

Other special pieces of equipment have also been introduced in place of cranes to handle certain types of traffic. Amongst these are bucket elevators to unload bananas for example and on certain ships, openings in the side have been made to enable the cargo to be discharged horizontally, thus avoiding hoisting operations.

Handling on Land including Ancillary Operations

It is the operations on the quayside which have shown the most important developments in recent years. Most of these have been introduced as a result of the methods employed by the American Forces at the end of the recent war in Western European ports; at that time a completely new technique was introduced, namely the fork truck and its associate the pallet for materials handling. In certain instances, pallets are not used, instead the fork truck in place of its normal forks is fitted with special handling attachments to enable it to come to grips with certain traffic, such as rolls of paper, cable and steel bars, without the necessity for the use of a pallet. The use of the fork truck combined with pallet trucks and tractor trailer trains has brought about a veritable revolution in port handling techniques.

Loading and Unloading Vessels and Ancillary Port Operations

(a) **Discharging Ships**

These operations fall into two categories depending whether the goods are in small unit loads or are comparatively heavy. In the first case pallets are necessary whilst in the second the goods can be handled directly on the forks of the fork truck. Where pallets are to be employed, the normal procedure is to receive the slings on a pallet on the quayside which is thereafter handled by fork truck. The same procedure applies to large crates which can be handled by the forks without a pallet. Variation must be introduced for certain traffic such as bales. For bales, the goods are normally dropped by sling directly on to the quay, the bales then being handled into transit shed or loaded on to surface transport by a fork truck equipped with clamps.

For fork truck operations it was an advantage if the cargo is all of one sort. If different kinds of packages are mixed in one hold, they must be sorted on arrival on the quayside and if the mixture is considerable, it is preferable to use other means of handling than fork trucks.

(b) **Loading Ships**

The difficulties in handling by fork truck cargo of different types and marks in the unloading operation are not so pronounced in loading operations as the traffic can be pre-sorted in the transit shed into different types before loading operations commence.

In these circumstances work is normally carried out as follows:

(i) On arriving by lorry or rail wagon the goods are unloaded and stacked on pallets if the packages are small or on dunnage if they are large.

(ii) When loading of a ship commences the fork truck fetches the loaded pallets or individual packages to the quayside under the hook of the crane. The pallet is then hoisted with the goods by means of a suitable type of sling and dropped into the hold where it is unloaded by the loading gang who stow the merchandise. The empty pallets are then returned to the quayside.

Palletisation in a port necessitates the holding of a considerable number of pallets. For example, in the Port of Marseilles the stock of pallets is in the region of 80,000. Fork trucks can of course be used without pallets either by using the forks to lift the goods directly or by employing the various types of auxiliary attachments which are available where they suit the goods concerned.

Circumstances where Fork Trucks are Unsuitable

When the horizontal handling distances to be covered are large, for example beyond 150-ft., it is considered that fork trucks should not be used for the horizontal movement. The fork truck is essentially a lifting device and should be used as such. In these circumstances the horizontal movement can be more economically carried out by tractor trailer train. The fork truck is employed in the vicinity of the surface vehicle to be loaded or unloaded or in the transit shed, the goods being taken on or off the trailers in the tractor trailer train by the quayside crane or ship's handling gear.

There are cases where a mixed cargo incorporating a large number of marks necessitates considerable sorting on discharge from the ship. In these circumstances, if the transit shed is near the point of unloading, mechanical handling appliances are of little use. Instead, the slings are dropped on to a wooden platform on the quayside and there sorted into different marks manually by the shore gang. If the storage shed is some distance from the ship's side, the slings can be dropped on to a tractor trailer train which takes them mechanically to the shore gang.

If packages are too heavy for fork trucks, it is often necessary to employ mobile cranes which are obtainable in capacities of up to 10 tons. Straddle carriers and side-loading fork trucks, which are new developments derived from the fork truck, are particularly useful for very long loads.

HANDLING ON BOARD SHIP, STOWING AND UNSTOWING

In most cases the same progress has not been made in hold operations as in quayside work. However, recent enquiries do reveal that modern methods are now being introduced. This is particularly true with unit loads but even with general cargo new methods are being introduced where the interior of ships are suitable for their application.

Thus, wherever the hatchways to the holds are big enough, slings are dropped as near as possible to the place of stowage of the goods in order to reduce to the minimum the horizontal movement of packages within the hold. This is a good method of working provided it does not unduly extend the work cycle of the hoisting gear.

Alternatively, the goods can be dropped within the square of the hatch by the hoisting gear and moved from there to the place of stowage by some transport medium within the hold itself.

What is the most suitable handling medium in the hold?

Fork trucks are limited in their work in the holds by factors which will be mentioned later. Roller conveyors will perform the horizontal work if the loads are either pushed on them or are moved by gravity. A third alternative for horizontal movement is to use small trucks having three or four wheels. With the exception of the fork truck, each method mentioned only provides horizontal transport. The packages still have to be stowed by hand and, whilst this may be adequate for light packages, something further is needed for heavier goods.

TRANSPORT AND HANDLING OF UNIT LOADS

While bulking of traffic within the port marks a decided progress over individual handling of each package on the quayside or in the hold, further advantages will obviously be gained if the goods concerned can be palletised between the two extremes of the transport chain and remain in unit loads all the way from the producer to the eventual consumer.

The use of containers does of course produce unitization of loading in this way. As a further development, goods are now grouped together with a pallet at the producer's premises and held in unit form during the transport to the premises of the consignee. This procedure realises in part the advantages offered by container transport and also restricts considerably the number of individual handlings to be given to each package.

In the first place, it is the railway companies who have apparently taken the initiative in throughout palletisation in a big way and are at present in process of creating a user transporteur pallet pool. Similar methods have been adopted in certain countries for sea transport, particularly in Denmark and in Scandinavia, generally for short sea voyages.

In France, trials in palletisation for sea transport are also in existence. The French Line have palletised cases of brandy from French ports to their destination in New York. At Marseilles, a large sugar refinery despatches sugar in cartons from its factory to the port of destination on maritime pallets. In the same port, copper ingots are handled in unit loads grouped together without pallets and weighing several tons. A French Study Group, constituted to improve traffic methods between France and North Africa, have carried out a number of tests in palletised transport between France and Algeria and these and other tests have produced results which permit us to set out in a general way the advantages and disadvantages of palletised transport.

The advantages are essentially:

(i) Better handling methods provided that the palletised cargo is of sufficient quantity to justify the forming of special palletised handling gangs and the use of mechanical handling equipment and that, moreover, the shape of the ship's holds permit the use of mechanical handling machines.

(ii) Reduction in thefts and shortages. For example, the French Line estimate that the reduction in thefts in cognac is sufficient to justify the costs of throughout palletisation.

The biggest stumbling block to the employment of unit loads in shipping is the loss of stowage space on the ship. This arises because ships' holds were not designed for the stowage of unit loads and are best utilised when they are filled with small packages. Palletisation therefore results in a loss of loading capacity in the region of 20%.

Furthermore, certain holds are not convenient for the employment of mechanical handling equipment and the stowing of unit loads. Coamings and manholes interfere with the movement of fork trucks and in certain holds the transmission tunnel is a further obstacle. Finally, the strength of the ceilings in holds and 'tween decks is often insufficient to support the weight of the fork truck.

CONCLUSION

Having described in a somewhat summary fashion some modern methods of handling used in ports, it is perhaps desirable to indicate some of the results which have so far been obtained.

There have been definite accelerations in the speed of handling cargo, although it is often difficult to give precise figures. However, it can be said that whilst by the older methods a rate of 100 tons a gang day was achieved for miscellaneous cargoes, rates of between 150 and 200 tons a gang day have been obtained by the use of fork trucks. Where goods have been consigned on pallets, an average rate per hatchway of 20 tons an hour was achieved in one case for a complete cargo. In similar conditions with consignments of 1-cwt. sacks a rate per hatchway of 30 tons an hour was reached.

When all the goods are grouped in unit loads, still better results are obtained. The ships of one Norwegian line, which once spent two days in port turnround, now commence to discharge in the morning and leave the same evening. In a general way it is estimated that if a ship is completely loaded with unit loads, either pallets or containers, and if mechanical means can be employed for horizontal and vertical movements for stowage and unstowage, normal rates of working can be doubled.

In addition to speeding up the work, it is certain that the employment of mechanical handling equipment can result in a substantial reduction in labour where the Port Authorities can readjust the size of their gangs.

Moreover, fork trucks permit a much better use of the area around the ship. The goods can be stacked higher and so increase the productive use of transit sheds by as much as 50%.

Finally, mechanical handling reduces the number of handlings for each package and cuts down in this way losses caused to goods as well as improving the conditions of work of personnel and reducing their fatigue.

There is no question that since the second world war, tremendous efforts have been made by Port Authorities to modernise their equipment and mechanise their operations. The new methods of handling have clearly now left their experimental stage and are applied today in a great number of ports.

The results that have been obtained have been due to collaboration between stevedores, shipowners, naval architects and the manufacturers of handling equipment; further collaboration will result in the extension and the general application of methods which have established themselves and proved their usefulness. It is suggested that this further work should be directed towards exploring the possibilities of building ships which will allow the full employment of mechanical handling machines on board, towards the problem of presenting traffic most suitably for mechanised handling and also towards the development of suitable mechanical handling machines.

Materials Handling and Ships

by P. C. Somerville

The ideal conditions for mechanised handling exist when at a fixed site one particular process is operating throughout twenty-four hours week after week under stable conditions of climate, temperature and light. Such conditions might occasionally, I am told, exist in a factory and this may be one reason why some manufacturers are away ahead of the dock labour industry in such development. Indeed it would be hard to imagine conditions more unsuited for mechanisation than occur when handling goods between ship and shore. In place of a fixed site there are generally two or more ports and a number of ships involved. In place of one process there are several and there may be a great variety of commodities. Where continuity of work is desirable a few ports may operate three eight hour shifts per twenty-four hours, but this is most unusual and it is more common to find work carried on a day basis plus overtime or on a two shift system. Then the five day week is out of the question and instead there is not infrequent work on the Saturday and Sunday, a very pronounced peak towards the beginning, and end of the week and often a slack or even idle period towards the middle. Finally the work is carried on in the open air exposed to all the vagaries of climate for which this country is notorious and even tidal effects must be taken into account. It is therefore evident that in shipping, mechanisation and materials handling of all

types must be extremely flexible and readily adaptable to the varying circumstances which will be encountered, but despite these factors, which are widely known, we in the shipping industry and in particular the dock labour part of that industry are often labelled as being unprogressive and unrealistic. I do not like admitting it, but the criticism is in part justified. In certain respects I think we have been shortsighted, but there are a number of extenuating circumstances, and in certain directions we can show examples of advanced thinking and prompt action which should be taken into account by those levelling the criticisms. To put these points in their proper perspective must be part of my task today; but I hope to carry you further than the making of a **joint** survey and give you some indication of how I at least, see future development of future trends.

Materials Handling and Shipping are almost synonomous terms. We in shipping must live by handling materials and the handling problem is bulking larger and larger as costs of ship operation mount. Almost every week one sees or hears some comment to the effect that half a ship's life is spent in port. That seems a strong statement; but for a great number of vessels it is less than the truth. In my own company's fleet the vessels average three days at sea and four days in port per week, without taking into account the time spent in port for repair or overhaul, and on figures I have received from certain other companies with vastly different types of ship proportions of time at sea and time in port are even more adverse, tending almost to approach the order of two days in port to one day at sea. Now beyond question the actual carriage of goods by water is still far the cheapest method of transport despite the now astronomical costs of shipbuilding; but if the ship has to spend two-thirds of her life in port, much of this advantage is lost.

Such being the case you must immediately wonder what is being done to improve the situation and whether such efforts as are being made are being applied intelligently and in sufficient quantity. To answer this we must establish who should be taking the necessary action. Should it be the shipowner desirous of rendering his particular ships or services more atractive or more economical than those of his competitors ? Should it be the Master Stevedore hopeful of increasing his clientele or his turnover? Should it be the Port Authority anxious to develop trade or even to conserve its traffic? Should it be the owner of the goods? Each of these has undoubtedly benefits to derive from improvements in turnround; but if large expenditure is likely to be incurred (and this is the case more often than not) then the benefits must be substantial.

In most cases development must result from a combined effort by all the interests and there possibly is one of the reasons why progress is so often slow and laborious. It is the exception rather than the rule to find a large factory or a large consumer sited right on the quayside and it is surprising how often we find quite sizeable works which must rely on import or export situated a considerable distance from a suitable port. This means that the discussions must involve not only the cargo owner, the port authority and the shipowner; but also probably road or rail transport and perhaps even the local authorities. Of course in many cases there are cogent reasons for choosing the particular site; but I do feel very strongly that there is room for much closer liaison between the manufacturer or large consumer and the port authority. When saying this I should make it clear that, through such liaison as this, much has already been achieved in particular with ore, grain, and fertiliser and other bulk traffics. My contention is that there is still room for development, and there are a number of port authorities which would welcome with open arms the opportunity of establishing contact with prospective importers or exporters.

After dealing with what he calls "basic cargoes" — coal, grain, fertilizers, timber — the author proceeds: As I said earlier general cargo usually forms the bread and butter of the normal port. How is it being catered for and if the situation requires to be improved what can be done? There is seldom anything very spectacular in the development of general cargo berths, and even in the case of the ferries and roll-on-roll-off vessels which I will mention later, the port aspect has received little more than passing mention. Yet a considerable amount of progress has been made, although it is not nearly so apparent as in some of the Continental ports, where the need for repairing extensive wartime damage has accelerated the programme of modernisation. Most of our ports in this country operate on very restricted budgets, and it is only natural that the funds available and the capital they could raise should be spent where they could be expected to give an early return. For this reason ports have, I think, tried to concentrate their spending on work which would attract new trades preferably in the larger type of vessel which is a better revenue earner, rather than in improving berths which, while not up to modern standards, were at least capable of meeting to a reasonable extent the immediate demands of the users. Now that trade has slackened somewhat, I imagine many port authorities are devoting more attention to the upgrading of these berths, and there is no doubt a great deal can be done for what, in comparison with the more grandiose works, can be considered fairly moderate expenditure. Some of the points which have to be studied in this connection are:

Transit Sheds—Any advantages which may have been conferred by bench height floors have largely disappeared with the advent of the fork truck, and I think it is generally accepted that ground level floors with their greater flexibility for access and egress are essential.

The old convex paved floors which sufficed when for a day's work the Custom's watcher laboriously entered the discharge of a thousand Dutch cheese, are now completely outmoded. They must be replaced with smooth concrete or stelcon rafts which are better suited to the small wheels and the speed of modern working. The dusty old skylight harbouring rooting pigeons and spiders can be replaced by small section astragals or perspex sheeting; and fluorescent lighting take the place of sooty bulbs and tarnished shades.

The shed apron is another area which usually merits attention. Quite frequently it is at a considerably lower level than the shed floor with the result that when a high loaded truck enters or leaves the shed it decants the packages over a quay that nine times out of ten is muddy and possesses numerous potholes. The quay surface itself is subject to very severe usage and almost certainly will have suffered. It is not uncommon to see old boiler plating or at least mild steel sheet laid over railway lines to provide a reasonable smooth running surface for fork trucks, or bogies; but that should not be necessary and once again concrete, stelcon rafts or even well-laid paving stones can do wonders to speed up movement.

Cranes form the next bone of contention between the port authority and shipowner and the stevedore. On the Day of Judgment they will still be arguing whether or not the ship should provide her own lifting gear, and if so whether it should be used and if not why the port authority must charge the earth for the use of its cranes.

With most traffics a shore crane is generally more satisfactory than any gear the ship can provide, for the simple reason that it provides greater radius, greater clearance, better observation for the driver and usually quicker hoisting, luffing and slewing than its shipborne counterpart. In addition one has the advantage that in most cases the craneman will be operating that particular crane day after day, while with the ship's gear the man operating the crane or winch may be doing so for the first time and it will

probably be comparatively strange to him.

It is however, important that the shore crane should be chosen for the job, and particular attention should be paid to the standard of visibility afforded to the craneman both for sighting the load he is lifting and for seeing in the direction he intends to luff or slew.

It is extremely difficult to decide on the correct capacity of crane required for a general cargo berth. If the cargo is being handled in normal sling or not, or on cargo board or pallet, a general purpose three-ton crane seems the answer; but there must be very few cargoes loaded these days which do not include a number of lifts each exceeding three tons. The usual practice is to include one six-tonner or more among the three-ton cranes, but even this does not always suffice as one does come across lift vans or containers exceeding six tons and it is an expensive business to shift the ship.

After considering the implications of the growing use of containers and the increasing volume of heavy lifts, Mr. Somerville examined the materials handling problem from the point of view of the shipowner.

From the earliest days, it has been essential for the proper design of ships that there should be the closest possible liaison between the prospective shipowner and the shipbuilder. One cannot expect the shipbuilder to be conversant with all the operational requirements for a given type of vessel as so many of these are peculiar to the trade for which the ship is destined and their purpose is only made clear once the vessel is in service. Others may be so trifling in themselves as hardly to warrant mention in the specification and yet in conjunction with other quite insignificant items may sway the balance operating at a profit or making a loss. In the same way the shipowner cannot hope to keep up to date with the latest structural developments, or to undertake the detailed design.

The relationship between owner and builder must therefore be of the closest possible nature and during the whole process of design and construction there should be frequent consultations and inspections; not just by the Naval Architect or Superintending Staff, but by those who will be concerned with the operation of the vessel.

Some companies make a point of consulting their agents and stevedores at all their major ports as well as their own stevedores and head foreman. My own firm carries out this practice and it is quite amazing how much valuable information has resulted from these little groups studying the prototype plan and discussing the pros and cons of this or that arrangement. Then again, much can be achieved from discussion with Masters and Officers with experience of the trade in which it is proposed to use the ship, with knowledge of the principal types of cargo expected to be carried or the type of ship in question.

Continuing, the author examined the advantages and disadvantages of the roll-on/roll-off "ferries," the specialised container ships, flush-fitting hatch covers and ships' derricks and cranes. He then turned to the point of view of the Master Stevedores, acknowledging that his problem is as great as that of any other interest. "If the Stevedore doesn't try," he remarked, "he cannot possibly succeed. If, out of ten trials, there are nine failures and one success, you have made progress."

"The training of personnel," he goes on to say, "is quite one of the most important parts of any programme of mechanisation, and not infrequently more difficulty is encountered among supervisory staff than elsewhere. To some extent this is understandable as they are the people directly responsible for maintaining the speed and standard of the work. If the ship is held up and misses her tide, if cargo is shortshipped, if the dockers are dissatisfied, these men get the first kick and one can hardly blame them if they are reluctant to introduce untried methods. Somehow they must be convinced, or at least persuaded that the innovation has possibilities because if they are only lukewarm in their support it will be very difficult for you and hopeless for them to get the men interested.

"Some of the courses on dock labour and cargo handling that have been run in recent years are very good and encouragement should be given for personnel to attend when this is possible. If that cannot be done it is worth arranging locally lectures, film shows and practical demonstrations. A number of manufacturers of equipment have made it quite a feature of such demonstrations and they have been most helpful."

Finally, the Author deals briefly with organisation. "On the quay, it is of prime importance to have good access for goods arriving and good advice of arrivals. With this latter point must be incorporated the need for documentary checks particularly in regard to the customs' requirements which due to the hold-up in the Free Trade area discussions are still with us. Incorrect or delayed documentation may interrupt the even flow of goods into the vessel and by causing havoc in your stowage arrangements spoil the beautiful friendship you hoped was developing between you and the chief officer.

"It is enormously important to have the goods forward in good time for shipment. On the other hand if they arrive too early they may impede movement on the quay, they may be pilfered or damaged, or simply be blocked in by other cargo and unavailable for loading at the appropriate moment. It is immediately clear from this that there is an imperative need for clear and far-sighted planning in the use of quay and shed space and in the ordering up of traffic. The result to the uninitiated may look like organised chaos; but the real test is whether or not it works. The task is often left to a shed foreman, or checker who may be first class in his own sphere; but may not know enough of the whole cargo loading plan to allow him to make the best use of the space. I am inclined to think that the broad outline of the shed or quay layout should be drawn up by someone more senior—possibly of managerial type and the foreman's duty confined to the supervision of the laying down.

"The cargo owner or his agent can, by making certain that the marking and numbering of his packages is clear, and that there is not too much of it, assist greatly in despatch. I am sure you will all agree that transport is suffering severely from the plethora of marks, sub-marks, numbers and so on that garnish so many consignments. It may be necessary to have the whole history of the goods stencilled on the outside of a package, but is can be an open invitation to pilferage. If all the detail is necessary then surely the shipping marks merit at least a paragraph to themselves—something which will stand out and at least give a sporting chance to the poor tallyman who may be dealing with several thousand such packages in the course of his day's work.

Mechanical Handling in Polish Ports

by K. Plutyniski and E. Obertynski

In the early post-war years our fundamental task consisted in the reconstruction of the ports destroyed during the war. I should like to remind you that in 1945 the Port of Gdansk was destroyed 49%, the Port of Gdynia 48%, the Port of Szczecin over 50%. Such being the case we started introducing cargo handling mechanisation only in 1950.

At present the sea ports of Gdansk, Gdynia and Szczecin rank as ports with good technical equipment and having experience of operating and technological problems. Our rates of operation do not differ from the rates performed by other European ports.

In 1958 the Port of Gdansk handled 4,963 thousand tons of cargo, possessed 76 cranes and hoisting facilities, 81,000 m² of

storage space in warehouses and 138 units of cargo handling facilities.

Gdynia in the same year handled 4,904 thousand tons by 76 cranes, had 142,000 m^2 storage space and 210 units of cargo handling facilities.

Szczecin handled in 1958 — 6,085 thousand tons having 66 cranes, 76,000 m^2 storage space and 135 units of cargo handling facilities.

It should be mentioned that the Port of Gdynia is a typical general cargo port, the Port of Szczecin concentrates on bulk cargoes, and the Port of Gdansk is a port with a mixed composition of cargo traffic which includes a large quantity of timber.

The basic factors which had decided in favour of introducing mechanisation were:

1. Shortage of labour in the ports, caused by the demand for workers in the reconstruction of the country.
2. The necessity to increase ship turn-round and to shorten the stay of Polish and foreign merchant vessels.
3. Social aspect—diminishing the physical effort of the port workers.

Independently of the above, the organisational structure of the Polish ports proved favourable for the development of mechanisation since they are administered by the State.

Experiments in Mechanisation

In 1950 when we began to introduce mechanisation of general cargo handling the first problems were as follows:

1. Improvement of the efficiency of cargo movement between the storage space and the ship and vice-versa.
2. Stacking height—i.e. the most efficient use of storage space in warehouses.
3. Mechanisation of sugar — and cement — cargo handling which are handled in large quantities in our ports.
4. Indispensable investments concerning port adaption enabling the introduction of mechanisation.

Up to 1953, we had brought into operation 2-ton electric platform trucks, 10 m. long stacking slat conveyors, 2-ton electric fork trucks and 15,000 pallets of the following sizes: 1,200 x 1,800 mm. and 1,000 x 1,600 mm. for general cargo, 850 x 1,350 mm. for cement. At the same time we encountered a lot of difficulties. The port workers were not accustomed to the palletisation method; the ramps of the warehouses and their floors were poor; switching nests in many warehouses were not suitably situated. The lack of suitable roads and cargo movement ways made very difficult the use of electric equipment. Moreover, it was necessary to secure adequate garages and battery charging equipment, as well as to train the indispensable operating staff. The adoption by the port workers of the new techniques required a very great effort both of the gangmen and the administrative staff, who worked out the mechanisation schemes.

In spite of this, after the first three-years period, mechanisation began to pay.

It should be mentioned that the efficiency of the port workers increased by 18% per man hour. It enabled an increase in speed of cargo handling by 15% on the average. The capacity load per m^2 of the storage space also increased. Before introducing palletisation, one of the warehouses in the Port of Gdynia (Warehouse No. 16) could hold 7 thousand tons; after introducing this method it was able to hold about 10 thousand tons of general cargo. At the same time the number of accidents taking place during the work decreased considerably, particularly the number of cases of hernia among the port workers.

For obtaining a considerable increase in ship loading and discharging speeds, the use of fork trucks for stacking and unstacking, the introduction of palletisation, the use of trucks for transporting unit loads, and the use of conveyors for stacking bagged general cargo, proved to be insufficient. In this matter neither the detailed investigation of the separate mechanical handling facilities nor the effort of the workers were helpful; nor were minutely worked out, technological charts of cargo handling methods.

Nevertheless, the positive results of partial mechanisation and the endeavours to shorten the ship stay in our ports arose from the widely understood conception of the methods of cargo handling mechanisation. That was 1954. At present many of our aims have been already realised or are in the stage of realisation.

Trends in the Development of Mechanisation

The conception of development of the mechanisation of cargo handling had been worked out based upon fundamental technological solutions. Mechanisation problems—especially in the field of general cargo handling—were treated jointly for the ports of Gdansk, Gdynia and Szczecin (taking into consideration, of course, the specialisation of each of them: e.g. Port of Szczecin—bulk cargoes, the Port of Gdansk—timber, the Port of Gdynia—general cargo) on account of the repeating technological schemes of handling the particular groups of goods or the homogeneous cargo handled in large quantities. There were accepted such trends of mechanisation which would guarantee the creation of ports possessing the highest technical and operating level.

Thus first steps aimed at the complex treatment of the mechanisation of heavy work and the following elements of the handling were acknowledged as the fundamental ones:

1. Mechanisation of ore trimming in the ship's hold for imports.

2. Mechanisation of bulk cargo trimming in the ship's hold and in railroad trucks, when handling by cranes and grabs.

3. Mechanisation of the handling and trimming of bulk cargoes (particularly of apatites and phosphorites) which, in the Port of Szczecin, are transported from the ship to open storage space, railroad truck or lighter. This can be achieved by the use of an adequate pneumatic plant, enabling an import capacity of about 5,000 tons per hour.

The introduction of stationary plants with a high capacity (above 200 tons per hour) for bulk cargo is a rather complicated matter and difficult to be solved technically, on account of an extensive range of granulation and different level of the humidity of cargo, which can very easily choke the plant and especially the air filters. Researches for an adequate solution of this problem caused the Port of Szczecin to contact Simon Handling Engineers Ltd. of Stockport, England.

4. When handling corn and industrial grains—the increase of the capacity per hour of the grain elevators by means of the use of an additional pneumatic equipment. The "Fahrbare Pneumatic Forderanlagen" (made in Germany), with a capacity of more than 40 tons per hour introduced into operation in the Port of Gdansk, enabled an increase in output of 1,000 tons per 24 hours. When handling a ship of 10,000 tons it makes a saving in foreign exchange of between 3-4 thousand U.S. dollars.

5. The mechanisation of timber handling in the Port of Gdansk and in the Port of Szczecin is at present a fundamental problem. This is difficult to solve considering the "in and out" handling of the pit-props, pulp-wood and sawn-wood. It is difficult to justify expense in this investment on account of the practical impossibility of introducing the palletisation method and on account of the fact that the timber sent to the ports often includes humid and dry timber, of different sorts, loaded together in the same truck.

The mobile cranes used in the Port of Gdansk on the Timber Station and the small locomotives transporting cargo to open storage places alongside the ship and vice-versa are a partial solution of this problem, but they do not produce a fundamental

decrease in labour requirements or an increase in cargo handling speeds.

6. Considerable development of general cargo handling, namely, (a) introducing horizontal conveyors for the cargo movement warehouse to railway truck and vice-versa, and mobile slat conveyors for handling the non-palletised bagged general cargo, cartons and small boxes ; (b) the increase of the weight of the unit loads transported over the ship's rail in order to improve the work capacity of the cranes and the work efficiency of the gang ; (c) introducing the palletisation method for general cargo movement—railway truck/open storage space/warehouse/ ship ; (d) improvement in the speed of cargo movement by introducing 10-ton diesel industrial tractors with 3-ton trailers instead of 2-ton electric trucks ; (e) introducing diesel fork lift trucks with a capacity of 1, 2 and 3 tons for all kinds of cargo handling including railway trucks and ships' holds ; (f) improvement of railway facilities on the general cargo quays ; (g) the increase of general cargo handling performed by mobile cranes with 6-ton lifting capacity, especially when handling in areas beyond the reach of quay cranes ; (h) the improvement and partial mechanisation of stowage ; (i) the improvement of manipulation in warehouses, ships' holds and railway trucks by introducing fork trucks with a capacity of 2 and 3 tons.

Apart from adopting these means the Port Authorities spend every year considerable sums of money in order to ensure among other things the indispensable maintenance accommodation, enabling rational and profitable equipment operating. These are enumerated as follows:

Six bases (two in each port) for 483 units of cargo handling equipment.

Special repair shops employing e.g. in the Port of Gdynia on the average 120 skilled specialists.

Reconstruction of ramps and of all floors in the warehouses in order to enlarge them and to render their surface adequate for the use of mechanical equipment.

Maintaining the concrete surface or concrete alleyways on open storage spaces, to facilitate the working of wheeled equipment.

Maintaining the surface on general cargo quays and substituting " flush " for " proud " railway tracks.

At the same time in new warehouses, e.g. Warehouse No. 21 in the Port Gdynia, the requirements of mechanisation are taken into consideration. This 6,000 m² warehouse has no pillars, doors are situated every 10 m. and there are ramps 6 m. wide. All this is considered as the minimum for satisfactory work. Moreover, if required by the operating conditions, the water sides of warehouses formerly possessing ramps, are reconstructed to be rampless, enabling easy access of the equipment to ship and free use of ship's gear. Two general cargo warehouses on the quay Ewa in the Port of Szczecin, were rebuilt in this way.

Independently of these improvements the Port Authorities of the separate ports pay special attention to the training of the cargo handling staff. In the last few years more than 1,000 persons have been trained theoretically and practically. Every operator receives, after being examined, a certificate authorising him to work with a particular kind of equipment. The number of the operators—apart from the repair shops, base workers and office staff—in all three ports together totals 672 persons.

The Mechanisation of Stowage

This depends on three fundamental factors, namely:

Construction of the ships and ship holds.

Kind, weight and packing of the stowed cargo.

Conditions and succession of the stowage.

The construction of modern ships takes into account factors rendering the stowage easy. There arose, however, complications on the ships of obsolete construction, which, unfortunately are at present in the majority.

The difficulties encountered when stowing cargo in a ship involves the consideration of such factors as:

Ensuring the security of the ship during her trip—among others, by stowing heavy cargo first.

Ensuring the possibility of the successive discharge of the separate consignments at the terminal ports.

Necessity of protecting the cargo with mats or dunnage.

Other factors resulting from the trade and shipping regulations as well as from the physical qualities of the goods themselves.

Thus when the cargo is a complicated one, when the ship's holds are filled or loaded with different consignments possessing different unit weights and different qualities, as well as being differently packed, the mechanisation of stowage is a very complicated task.

Since the introduction of fork trucks for the work in ships' holds there appeared gradually special methods of cargo handling, that have been accepted in daily work. The results obtained proved that the work efficiency increased when stowing e.g. sheets, from 100 tons per shift when using non-mechanised stowing to 250 tons after introducing fork trucks. In addition, the gang was decreased from 6 to 3 stevedores.

When loading on the ship palletised goods which afterwards leave the harbour without pallets e.g. cement, the stowage technique when using the electric fork trucks is as follows:

The " hive " lifted with the pallet into the ship's hold is picked up by the fork truck from the floor of the hold. Then the fork truck carries it to the place of stowing and lifts it to the required height. The stevedores then take the separate bags from the pallet and place them in tiers. Of course, the height of lifting the cargo is limited by the height of the 'tween decks and the lifting capacity of the fork trucks.

Summing up, it should be stated that although the fork trucks do not by any means solve all the problems of the mechanisation of stowage in the ship's hold—the improvement is about 15-20% —they can nevertheless considerably facilitate the work of the stevedores and increase the loading speed.

The Economic Effects of Mechanisation—Conclusions

It should be stated that mechanical cargo handling is for us rather expensive. Nevertheless, in the final balance, it is economic, as the following figures show:

1. In the period 1954-1957 the work efficiency—in man hours —increased by more than 27% in the Port of Gdansk, 13% in the Port of Gdynia, and 25% in the Port of Szczecin.
2. There was also improved use of the storage space in warehouses in all cases where palletisation was applied. This meant considerable saving in warehouse investment.
3. Taking into account the change of the composition of the general cargo traffic which tended towards a decrease in the amount of semi-bulk cargo—there took place an effective decrease of the labour force in the last 4 years, of more than 600 workers.
4. At the same time, cargo handling speeds were doubled. The rates of working exceeded as a rule 1,000 tons per 24 hours in general cargo handling, and in consequence, the stay of ships in port was shortened by half.
5. In the commercial agreements e.g. by 184 ships in 1958, a total of 55,000 U.S. dollars was saved in freight payment.

The obtaining of these results was undoubtedly influenced by the mechanisation of the cargo handling which was developed in a systematic and logical way. It is proved by the fact that, in 1958, the cargo handling equipment worked 105,000 hours more than in 1957, an increase of 36%.

Pre-Cooling Stores at Cape Town

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Perishable Products Export Control Board*.

Introduction

This article will describe some aspects of the design and construction of the Cape Town Pre-Cooling Stores from the point of view of the refrigerationist. It is impossible, in the scope of a few pages of semi-technical notes, to give more than a glimpse of the planning which has gone to make this large installation a reality, but it is only right that recognition be given to the part played by numerous technical departments of the South African Railways. The Perishable Products Export Control Board acted as refrigeration consultants to the South African Railways throughout the work and prepared the general layout of facilities, recommended the type of insulation and drew up the designs and specifications for the refrigeration plant. There were, however, many other important phases of the work; for instance, the Chief Civil Engineer's structural department designed the building; the Chief Electrical Engineer's staff designed and specified the complete electrical power supply arrangements, switchgear and motors for all components; the Chief Stores Superintendent's staff undertook the placing of the many contracts for material and, perhaps most important of all, the System Harbour Engineer of Cape Town and his staff supervised all building and installation of equipment, and undertook much local design, the bulk of the construction work being carried out departmentally. Many contractors rendered fine service, but space prevents mention of these firms individually. Finally, the writer wishes to pay tribute to his immediate colleagues; the technical officers of the Control Board, and wishes to draw attention to the contribution they have made in the research, planning, and construction of the pre-cooling stores. This was truly a " team job," in which the enthusiasm of all concerned and their ability to co-operate made the early completion of the project possible.

The planning of the " D " Berth Store and the selection of plant and insulation materials had been completed when, in January, 1958, the disastrous fire at " B-C " Berth crippled the whole existing system. Not only was this setback made good, but by a directive of the Minister of Transport the second stage of expansion planned for " D " Berth was initiated and brought to completion in exactly half the time originally scheduled. Memory fails to recall a project of similar magnitude and complexity completed in such a limited time, except possibly under the stress of war.

General Features of Design and Site

Pre-cooling must be regarded as the first and most important link in the " cold chain " system, through which our fruit and other perishable exports pass on their way to Europe and elsewhere. The fruit pre-cooling stores at Cape Town are of critical importance inasmuch as they serve the area from which the delicate deciduous fruits are exported. Pre-cooling stores are necessarily expensive because they have to be erected on pile foundations alongside shipping berths in two-storey structures which have many other functions to fulfil; also because provision has to be made for powerful refrigerating plant for the rapid removal of the field heat from large daily consignments of export fruit. The pre-cooling chambers have also to be spread out alongside a number of berths, so that pre-cooled fruit can be transferred to the ships' chambers without the rise of temperature exceeding one or two degrees. In practice, the limitation in exposure time for pre-cooled fruit in transit to the ship is about five minutes or, in terms of distance and allowing for the time on the crane, approximately fifteen hundred feet of lateral movement is permissible between pre-cooling chambers, and point of lifting by the crane.

Aerial view of the fire of 1958, showing the gutted B/C sheds and the damaged gantry and the partly damaged sheds at the South area.

Position for Pre-Cooling Facilities

The view has been advanced from time to time that the pre-cooling stores are wrongly situated and that they should be located at or near the point of harvesting ; those who advocate this dispersal of facilities advance the argument that time lost between picking and reaching the specified temperature for carriage overseas is critical, bearing in mind the storage life of the fruit and its optimum requirements. This argument, in the writer's view, is partly valid but is too limited because it ignores the economic and technical factors associated with the provision of a large number of pre-cooling plants. These would all have to be designed for heavy peak loads for extremely short seasons and, even more important,

* This article, kindly supplied by South African Railways, was also published in " The Deciduous Fruit Grower," Feb. 1959.

it would become necessary to transport fruit pre-cooled in the country districts, in properly refrigerated trucks or lorries, to the point of shipment. For instance, to maintain a regular service of refrigerated vehicles for even the present rate of daily arrivals of fruit would require upwards of a thousand refrigerated vehicles, with either icing plants or maintenance stations for mechanical units.

The dispersal of pre-cooling facilities would finally leave unsolved the problem of holding pre-cooled fruit at the Docks for one or two days extra, when vessels are unexpectedly delayed, as is frequently the case. Accepting that it is desirable that the time between harvesting and completion of pre-cooling should be shortened as far as possible, the more correct approach would seem to be :

(a) to extend back to the pack-sheds the system of mechanised handling on skids or pallets which is used in the pre-cooling stores ;

(b) to utilise both road and rail transport to speed up deliveries to the pre-cooling store ;

(c) to introduce day and night working in the reception air-locks, and

(d) to introduce bulk handling and hydro-pre-cooling for at least a proportion of the expanding apple exports and to centralise this development alongside the point of shipment.

Such methods and possibilities hold out hopes for economy and improvement and are under close study by the Perishable Products Export Control Board at the present time ; the facilities now under description are designed to allow these developments to be realised without major structural changes. Hydro-pre-cooling can, for instance, make any extension of building for pre-cooling purposes unnecessary in the foreseeable future.

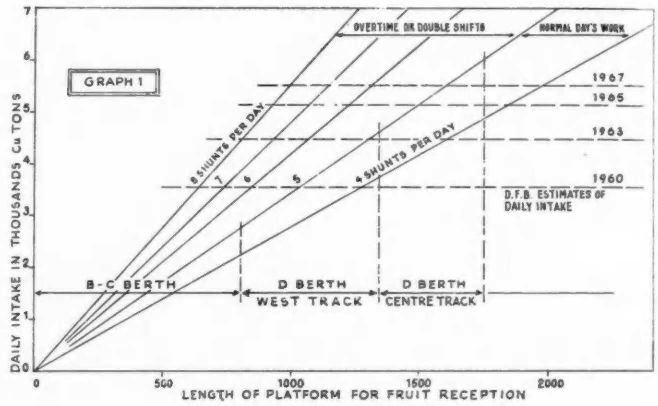
It is impossible to consider the pre-cooling store at "D" Berth as an independent unit and the decision to rebuild "B-C" Berth installation was taken after study of estimates of the growth to be expected in the export of apples, grapes and pears over the next few years. The combined facilities have to be adaquate, obviously, in all phases of operations ; e.g., reception-platform length and width, pre-cooling chamber capacity, plant capacity and handling and shipping equipment ; some of the factors under these headings are set out below :

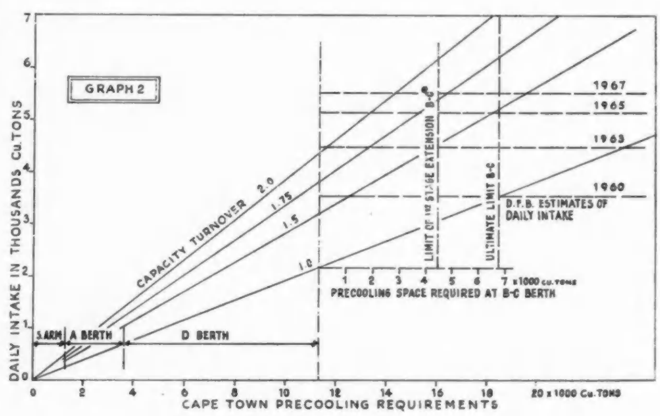
Length of Reception Platform

The system of packing and railing in vogue in the Western Province imposes a pattern of four peak days of 20% per day of the weekly arrivals and with the remainder spread over the other two working days ; labour habits and tradition make any change in this pattern most unlikely. The fruit trains received on any peak day have to be dealt with in batches or shunts ; Graph 1 shows the method by which the length of reception platforms is determined, taking into account the delays for placing trains or trucks in the sidings and the time required for transferring the fruit packages from trucks to the wheeled fruit skids used. The cubic ton unit used is a space unit adapted for shipping purposes and represents the volume occupied by 25 boxes of apples, 50 trays of grapes and 28 boxes of pears. The estimates for "daily arrivals" have been developed from crop production data made available by the Deciduous Fruit Board. The length of time occupied in unloading trucks makes it possible to handle up to five "shunts" daily at any one platform; more than that amount entails overtime working or eventually extra shift working. The growth of exports indicates that receipt of 3,600 cu. tons daily in 1960 will expand to 6,000 cu. tons daily in 1967 and the corresponding length requirement of reception platform (used five times daily) will increase from 1,100 feet to 1,600 feet. The provision made at "B-C" (as reconstructed) and at "D" Berth indicates that sufficeint allowance has been made up to 1967, which in terms of pre-cooling construction programmes, is in the immediate future. Longer working hours or possibly the introduction of improved handling methods are anticipated to ease the potential congestion before that point is reached.

Capacity of Pre-Cooling Facilities

It is possible, theoretically, to consider the "turn-over" of the pre-cooling chambers as rather more than twice weekly, but there are a number of practical factors which impose severe limitations. Among these are the necessarily irregular intervals in the arrivals of ships, the shorter loading times at week-ends, the delays occasioned by unseasonable rainy days which interrupt shipping, accidents to ships' refrigeration facilities and the accumulation of specially segregated shipments for markets other than the United





Kingdom. In normal working it has been found possible to pass through the pre-cooling stores about one and one-half times the capacity of the chambers in any one week. Graph 2 shows the pre-cooling capacity required for weekly turn-overs of 1.0, 1.5, 1.75 and 2.0, using the data on estimated exports up to 1967. .Allowance has been made—

for arrivals of 20% on eath of four working days with the remaining 20% spread over the rest of the week ;

for a turn-over of once weekly at the older South Arm pre-cooling store ; and

for special shipments to the U.S.A. which require special prolonged treatment.

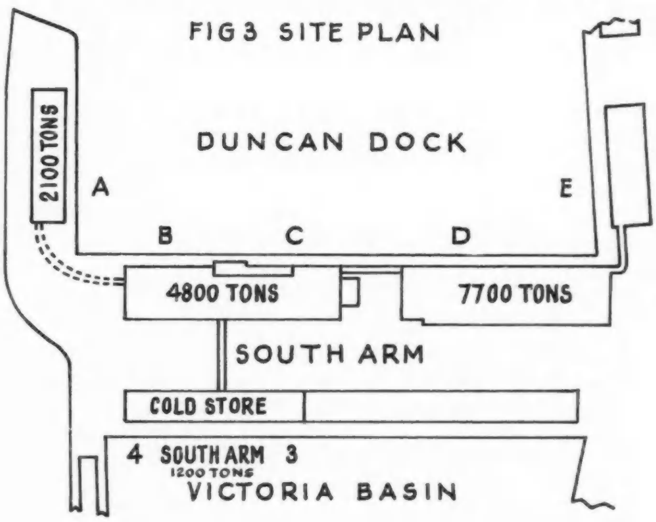
It will be seen that by 1965 under the present methods the full capacity of the reconstructed "B-C" Berth, in addition to "A" Berth, South Arm and "D" Berth, will be fully taxed. It is anticipated that by this time relief may be available following the

development of other methods of pre-cooling, such as hydro-pre-cooling, which can be utilised to cope with the expansion.

The disposition of the pre-cooling facilities on the South Arm at the Duncan Dock can be seen in the small site plan Figure 3. It will be noted that by the construction of a short gallery from "D" Berth to "E" it is now possible to ship fruit at all berths from "A" to "E," and also at South Arm Nos. 3 and 4; a total of seven shipping berths.

Pre-Cooling Refrigeration Capacity

The destruction by fire of the "B-C" Berth pre-cooling store did not include the refrigerating plant in the engine room, which fact enabled the deciduous fruit export trade to continue during 1958. The existing 30 years' old plant at "B-C" Berth had been just sufficient in 1957 to deal with the refrigerating load from "A," "B" and "C" Berths and the South Arm; the reconstruction of "B-C" to provide 4,860 cu. tons of high efficiency pre-cooling space necessitated a re-design and expansion of the compression and brine cooling plant. The refrigerating plant for "D" Berth has been placed alongside the existing plant but has for a number of reasons been kept independent of the older equipment. The



"D" Berth plant is intended for a short operating season of five months at full pressure and is, therefore, designed with much less than 100% reserve capacity.

At "D" Berth the plant has been designed to deal with daily receipts of half the capacity of the store, in the proportion of two-thirds apples and pears and one-third grapes; although the proper pre-cooling to carrying temperature takes longer than 48 hours for pears and apples, the brine cooling and circulation capacities have been adjusted to this time. With due allowance for heat produced in respiration of fruit, heat equivalent of work done by fans, flow through insulation, and all other sources, the maximum output of the "D" Berth pre-cooling plant has been designed at 14 million British Thermal Units per hour to deal with a requirement of 8 million British Thermal Units per hour. The total connected horse-power serving "D" Berth in the engine room is 2,420 H.P. and in the "D" Berth plant, including fans, is over four thousand. Throughout the whole group of pre-cooling stores the total connected horse-power will be over eight thousand when the present construction target is reached in 1960.

Handling and Shipping

The entire pre-cooling system at all Union ports has been based upon the use of the wheeled skid, or platform 8ft. x 5ft 2in., which carries up to 4 tons weight, which is the maximum lifting capacity of the cranes in use at this port. These wheeled "skids" have a number of individual package handlings and are transported through the reception platforms, corridor and galleries on low-lift platform trucks, battery operated; the provision of these vehicles for Cape Town has now exceeded fifty, while the number of fruit skids exceeds four thousand. The fruit skid, introduced in 1925, controls the design and dimensions of the whole pre-cooling store, particularly of the pre-cooling tunnels; to introduce any change in dimension or design of this equipment is naturally extremely difficult.

The system of fruit skids and battery-operated trucks has proved itself over many years to be extremely flexible, allowing a rapid concentration at desired points which is not obtainable by a more rigid system of handling. The design of fruit reception platforms on the ground floor and of pre-cooling chambers on first floor levels necessitates the use of lifts; these are designed to take either two fruit skids or alternatively a battery-truck plus fruit skid and do not represent a bottleneck in handling; five lifts have been provided at "D" Berth, each capable of dealing with 16,000lb. loads

A special service station and garage, with battery charging facilities, has been provided for the vehicles which will normally operate at "D" Berth.

Methods of Cooling

Air has always been the medium of transfer of heat from the packed fruit in our pre-cooling stores. Until recent years ammonia was circulated through the cooling coils in the pre-cooling chambers; the growth of the facilities and their dispersal over a long frontage has made the use of a secondary refrigerant desirable and calcium chloride brine is now circulated. Brine lends itself to that smooth control of air temperature which is so desirable with a large number of chambers and in particular brine lends itself to modulated control of flow by the system of remote control which has now been introduced for the ninety-six new pre-cooling tunnels at "D" Berth.

In past years, pre-cooling chambers were of large capacity, e.g., 72 skid-loads, and employed an overhead system of air delivery from false ceilings, the air passing downwards into floor openings for return to the cooling units.

The work of the research team led by the late Dr. A. J. M. Smith in 1938-39 indicated the advantages of more rapid air movement along the rows of wheeled skids and not vertically downwards over them. Pre-cooling tunnels, based on this research work, have become the standard pre-cooling unit and have a capacity of 18 wheeled skids or 81 cubic tons of fruit. The relatively small size of the pre-cooling tunnels enables the "shut down" time for loading or shipping to be cut to a minimum and permits the segregation of consignments, varieties and techniques which has become so necessary in recent years. The existing pre-cooling tunnels have the following overall specification:

Capacity is 18 skidloads or 81 cubic tons.

Air circulation is 30,000 cubic feet per minute at top speed at 2in. static water gauge and 17,000 cubic feet per minute at low speed. Also less 30% in reverse at each speed.

Cooler surface is 1,200 square feet of plain pipe coil, arranged athwart the airstream.

Brine supply reaches a maximum of 60 gallons per minute but is normally 50 gallons per minute for ± 12 hours and is thereafter modulated by remote control. The rate of heat removal for the first twenty-four hours averages 160,000 British Thermal Units per hour.

Length of tunnel is 77 ft.; width 11 ft. 6 in.

Height to deck is 6 ft. 10 in. Height inside insulation is 13 ft.

One fan and cooler are mounted above each double row of skids and there are access doors at each end of the tunnel.

The performance of the pre-cooling tunnels with air delivery temperature reduced to and held at 30°F. and with fans at full speed is such that it is possible to ship grapes 36 hours after receipt at the stores and pears and apples 60 hours after receipt.

The uniformity of temperature in the pre-cooled fruit at time of shipment is also satisfactory. Grapes cool approximately twice

Entrance to the pre-cooling tunnels.

as fast as the apples and pears and to a closer uniformity of temperature.

The performance of the pre-cooling tunnels has so far not been surpassed by other systems of pre-cooling which have been tested by the Perishable Products Export Control Board. Over a period of twenty years a number of other methods of air circulation for pre-cooling have been considered and tested, but none has produced the uniformity or general speed of cooling realised in the tunnels.

Type of Refrigerating Plant

The design of the " D " Berth brine-cooling plant introduces a number of departures from precedent. Earlier designs had sought to satisfy the need for flexible control to variable demand for refrigeration by installing a number of compressors, all closely interlocked with headers, valves, and manifolds. The price of refrigerating equipment has increased steadily at the rate of 6% per annum over the past twenty years and is now so high that simplicity of design is economically, as well as electrically, necessary.

Taking a lead from the compact arrangement of modern centrifugal refrigerating plants, the writer proposed a group of high-speed multi-cylinder ammonia compressors, each of which was arranged directly alongside a shell and tube evaporator and condenser; the refrigerant pipe-lines were thus extremely short and there was no manifolding of ammonia piping nor interlocking of the compressors. Each pair of these brine-cooling units is served normally by one brine-circulating pump of 1,200 gallons per minute capacity which is linked through a pair of brine mains to a group of about thirty pre-cooling tunnels. The only refrigerant cross-connection to these cooling groups takes place outside the pre-cooling tunnels in the brine mains gallery at " D " Berth.

The compressors, of multi-cylinder W. type, are reasonably low priced, compact, and of flexible capacity; all parts are renewable; they were selected because they have the inherent advantage that power required falls off approximately in proportion to the output. By a control arrangement which holds open the suction valves in the heads of the cylinders the capacity can be reduced quickly to 75%, 50% and 25% of full output for each compressor. The power requirement at 25% output is approximately 30% of full load, which represents an improvement on the performance of the clearance pocket and similar devices of past years.

For condenser cooling it has been necessary to circulate sea-water from the adjoining Duncan Dock; following up a suggestion that this water was cold enough (59°F. to 60°F. in summer) to be used twice over, a design was prepared in which the sea-water was circulated first through shell and tube condensers of the older " B-C " Berth plant and thence through the newer " D " Berth plant. A simple header arrangement allows for alternative use in either plant in parallel arrangement. The second use of the sea-water, which is warmed approximately 7°F. in each stage, has proved effective in practice. The extra power used by the rather larger pumps and by compressor motors operating at higher temperatures of condensation for part of the plant costs approximately £1,000 per annum, but the elimination of a costly tunnel and intake piping, plus separate sea-water pumps, has saved on depreciation, interest, and pumping costs well over £5,000 per annum. For the control of growth of shellfish inside the water piping, arrangements have been made for the periodical isolation, draining and filling of the condenser tubes with fresh water and for the injection of small amounts of ammonia into this water; it is hoped by these measures to control, or at least to reduce, the troublesome growth of shellfish in the condenser plant.

The circulation of brine to the many pre-cooling units and the accurate modulation of flow presented a serious problem.

Shipping fruit from the newly completed D shed.

Manual control of brine flow was preferred because some pre-cooling techniques demand that air-delivery temperatures should be kept well within 1°F. of a specified temperature. However, the labour cost of operating up to two hundred separate pre-cooling rooms made it essential to devise a central-operated system. After a year's research, in which remote controlled valves of various types were tested, a system was devised whereby each brine-return pipe

from the individual pre-cooling unit is fitted with a pneumatic-controlled modulating brine valve, which is in its turn controlled from panels below the recording thermographs in the engine room; the recorders show the temperature of air delivered to each pre-cooling tunnel. All this equipment is brought into one central control-room inside the engine room; although the distances of the various coolers from this control-room may be a quarter of a mile, it is possible to obtain a quicker alteration of air temperature delivered to the fruit by an adjustment of the pilot-valves than by any other known method. The manually-operated remote control system features the one refinement not possessed by any automatic control, which is the ability of the operator to predict the trend of temperature from his own observations and to make the correction before, and not after, the temperature has deviated from the desired point. This remote control system is supplied with dry compressed air from a specially designed plant installed above the new engine room; air drying is by means of silica-gel adsorbent and a regeneration plant for removing moisture from the silica-gel trays has also been provided.

The quantities of refrigerants used were considerable and it is worth noting that the normal plant charge of anhydrous ammonia for "D" Berth alone is eighteen tons and that approximately one hundred and fifty tons of calcium chloride were dissolved, in special mixing tanks, to make up the full charge of over sixty-two thousand gallons of brine.

Insulation

The pre-cooling tunnels at "D" Berth are insulated with resin-bonded glass-fibre batts, which are placed on the tunnel floors, ceilings and partition walls. The outer or warm surface of this glass-fibre is covered with two layers of aluminium foil which are bonded to the concrete surface of the structure with a latex adhesive; the inner or cold face of the insulation is left permeable to the passage of moisture. Expanded polystyrene slab insulation, secured with latex adhesive, is used in insulation of corridor ceilings, the brine pipe gallery and the end-walls of the tunnels. It is of interest that these insulations are all manufactured in the Union and that they are either fire-proof, e.g., glass-fibre, or have been rendered resistant to fire by an impregnation process. The many insulated doors to the tunnels, which cover a door opening of 11 ft. 6 in. x 6 ft. 10 in., are of special lightweight design, using aluminium panels and glass fibre insulation, and are fitted with rubber gaskets to prevent air leakage from the tunnels. The resistance of the close-stacked tunnels to the flow of air exceeds 1 inch of water, so that the doors have to be well sealed to prevent leakage.

Conclusion

While much remains to be achieved, it is gratifying to note that first results from the "D" Berth plant are encouraging and an example of performance is the recent shipment of nearly eight thousand cubic tons of pears and grapes in the "Roxburgh Castle" (wholly from "D" Berth) in which the many temperatures of fruit taken in all the tunnels prior to shipment ranged from a minimum of 30.0°F. to a maximum of 31.5°F. By the application of such uniformity of pre-cooling to our fruit exports we can hope to improve on the performance of the past, in which congestion of facilities proved such a large handicap. It is finally pleasing to record that this plant was designed in South Africa and that it appears that no less than 85% of the plant and machinery installed was manufactured in our country.

Japanese Study of a Pneumatic Breakwater

Third Full-Scale Test under natural conditions during the 11th Typhoon (1958) at Tsurumi Shipyard, Yokohama, Japan.

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In the Tsurumi shipyard of the Nippon Steel Tube Company at Yokohama ships moored at the fitting-out quay have sometimes been difficult to moor and have been severely damaged during typhoons and spring gales. This was due to the synchronisation of the wind force acting on the hull and the force of the waves entering the narrow space between the hull and the quay; the two forces considerably increased the motion of the ships. To avoid these difficulties a pneumatic breakwater was adopted in 1956.

The depth of water near the quay is 6.5 m. at L.W.O.S.T. and the mean depth is 7.7 m. This is shallow for the calming of storm waves and it was thought that the plan might not succeed. The fitting-out quay is in the inner part of the shipyard basin which itself measures 300 m. in width by 1,000 m. in length. With a fetch of 20 km. to the south across Tokio Bay, the wave length is not likely to be long even in a typhoon.

A test installation was set up in August, 1957, but a year passed before a chance came to test it with long waves in Typhoon No. 11 on 23rd July, 1958. While the storm was raging the shipyard basin was exposed for a long time to a strong southerly wind, the mean velocity of which was 25 m/sec. and the maximum instantaneous velocity was 40 m/sec. The waves within the basin were so rough that a tanker of 45,000 tons rolled and pitched heavily. The electric power supply was cut off by the violence of the wind and the operation of the pneumatic breakwater was stopped. Fortunately this accident occurred just after the most violent part of the storm so that the hull and the quay were safely protected from the most dangerous waves by the working of the pneumatic breakwater. Indeed, after the air supply for the pneumatic breakwater was stopped, waves broke against the quay and equipment on it was severely damaged.

Details of the arrangements and of the results are described in Bulletin No. 12 (1958), of the Research Institute for Applied Mechanics, Kyushu University.

Design of the test installation

In order to use compressed air efficiently the perforated pipes for the pneumatic breakwater were placed about 10 m. ahead of the bow of the ship so as to cover the triangular space between the hull and the quay. In this way the waves were expected to be attenuated by the current induced inside the triangular area in addition to the true reduction caused by the turbulent viscosity from the pneumatic breakwater.

The shallowness of the water made it difficult to carry out this plan. Eventually a ladder type of the perforated pipe was adopted as a suitable method for use in shallow water. It consisted of two longitudinal pipes in parallel connected together by a series of short perforated pipes like the rungs of a ladder. The main pipes of the ladder were 5 in. dia. with 23 crossing pipes of 3 in. dia. at one metre intervals with holes 2.5 mm. in dia. drilled at the rate of 94 holes per metre. Two of these ladders were made, one 1.5 m. and the other 2.5 m. wide, together with a normal

straight type of pipe as a standard for comparison. This was 5 in. dia. and it also had 2.5 mm. dia. holes at 94 per metre.

It was found by measuring the velocity distribution that the thickness of the horizontal surface current induced by the ladder type of pipe was 20/30% greater than that induced by the straight standard pipe. The pipes were fully galvanised to protect them from corrosion with the result that the ejection performance showed no appreciable change over a year.

Waves during the storm

From the dawn on 23rd July the wind velocity began to increase, reaching 20 m/sec. by 5.00 a.m. and 25 m/sec. by 7.00 a.m. This velocity continued for about two hours after which the wind gradually subsided. As the wind velocity rose the waves became rougher, with some phase lag, and their period became 4 sec. (λ = 25 m.) at 6.00 a.m. and eventually 5.2 sec. (λ = 42 m.) at 9.00 a.m. when the wind velocity had passed its maximum.

The wave recorder operated until 7.30 a.m. when it was carried away by the storm. The mean period and wave height of significant waves, selected from the wave records, were computed as follows:

Original and Reduced wave heights in the triangular area between the ship and the quay

1	2	3	4	5	6	7	8
Time; a.m.	5.05	5.25	6.00	6.12	6.41	7.22	9.00
Wind Velocity m/sec. ...	20	20	20	20	23	25	25
Original wave period sec. ...	3.29		3.98				
Height m.	1.37		1.36				
Reduced wave period sec.		3.55		4.07	4.21	4.99	(5.2)
Height m.		0.74		1.21	1.79	1.65	(1.9)

It will be noticed that between the sixth and the seventh columns there is a fall in the height of the reduced wave even though the speed of the wind had increased from 23 to 25 m/sec. This is due to the effect of the shape of the triangular region between the ship and the quay with its entrance 16 m. wide.

Column 8 shows the character of the waves at their highest, as estimated from the conditions at 7.22 a.m., by using C. L. Bretschneider's formula established preliminarily in this basin with modified co-efficients.

Operation of the Pneumatic Breakwater

Air up to the rate of about 100 m.^{3}/min. had been supplied to the perforated pipe from 3.00 a.m. until the accident occurred at 9.10 a.m., ten minutes after the wind had reached its peak. We were fortunate enough, therefore, to have completed the wave reduction test during the height of the storm, though the observation was made with the naked eye.

While the pneumatic breakwater was in operation the bulk of the waves did not over-flow the quay though some spray came over it. When the air discharge ceased at 9.10 a.m., waves began to flow on to the quay though the storm condition was not appreciably altered and it was frequently observed that the wave crests were 30—50 cm. above the level of the quay in the triangular area between the ship and the quay.

Experiment No. 1. Col. 8

From this last observation it was estimated that the waves of 5.2 sec. period (λ = 42 m.) were depressed by 20% of their height. This calculation takes into account the raised water levels due to the wind and the lower barometric pressure in addition to the effect of the ordinary tide. The 2.5 m. wide ladder was used and 89 m.^{3}/per min. was delivered to it.

Wave reduction tests.

The following further observations may be made from the figures in the Table:

Experiment No. 2. Cols. 2 and 3.

From 5.00 a.m. to 5.30 a.m.

a. The mean wave period was 3.42 sec. (λ = 18.5).

b. The reduction ratio was 0.54 with a true reduction ratio of approximately 0.3 ... ... (1)

c. The air consumption was 115 m.^{3}/min.

d. The width of perforated ladder pipe was 1.5 m., depth 7.5 m.

Experiment No. 3. Cols. 4, 5 and 6.

From 6.00 a.m. to 6.41 a.m.

At this time the wind and waves were so violent that it was not possible to compare records of the original and the reduced waves directly. Consequently, the mean heights of the reduced waves at 6.00 a.m. were estimated from those at 6.12 a.m. and 6.41 a.m. by extrapolation.

a. The mean wave period was 4.0 sec. (λ = 25 m.).

b. The reduction ratio was 0.78 with a true reduction ratio of approximately 0.77 ... ... (2)

c. The air consumption was 74 m.^{3}/min.

d. The width of the perforated ladder pipe was 2.5 m., depth 7.6 m.

The reduction ratios mentioned above are apparent ones. The effect of the pneumatic breakwater with its opposing surface current and turbulent viscosity is to reduce the height of the original wave to the lower height of the transmitted wave. The reverse surface current on the protected side of the breakwater lowers the height of the transmitted wave further.

On the other hand, in the protected zone the wave height is increased by diffraction of waves round both ends of the pipe. The true reduction ratios shown above have been deduced from the apparent reduction ratio by eliminating the last two factors. The results of the calculations are shown in lines (1) and (2) above.

Comparison with theory

The results of the reduction tests shown in Experiments Nos. 2 and 3 above have been compared with those predicted theoretically from the air consumption by the wave-length-depth-ratio—parameter ξ relation (Modified form of equation (8) in "On the Study of a Pneumatic Breakwater IV," Reports of Research Institute for Applied Mechanics, Kyushu Univ., Vol. 5, No. 20, 1957), which is as follows:

	H m	H_e m	Q l/sec.m.	ξ	r_0	λ m	λH_e calculated	λH_e observed
Ex. No. 2	7.5	9.4.	83.2	9.2	0.3	18.3	2.0	1.94
Ex. No. 3	7.6	9.5	53.7	5.8	0.77	25.4	2.6	2.68

The performance of the pneumatic breakwater at the height of the typhoon can now be estimated theoretically. The wave length was 42 m., air consumption 64.5 l/sec. and the mean velocity in the triangular region between the ship and the quay was about 0.68 m./sec. With these data the theory gives a true reduction ratio r_0 = 0.89 and an attenuation ratio of 0.93 caused by the reverse surface current. With negligible diffraction we have the apparent reduction ratio of 0.83. This figure conforms to the facts as observed by the naked eye before and after the highest period of the waves.

New Methods used in Dyke Building

Nylon Fabric as Foundation Material

The Delta Plan, details of which appeared in the August, 1958, issue of this Journal, calls for the closing of so many wide, and sometimes swift-moving masses of water that it has given rise to the study of new methods of dam and dyke construction and to the use of new materials for the foundation bed on which the whole dyke structure depends.

Among the latter, recent technical progress at once pointed to plastics and nylon as worthy of experiment. Both were therefore tested, with the result that nylon tissue was found more suitable as foundation material. It has great tensile strength combined with great elasticity, and the additional merit of not tearing further if it becomes damaged in any particular spot. It is also satisfactorily permeable to water, almost completely sand-proof and proof against decay.

The first tests were made with a mat which was laid down on the sea-bed from a sledge pulled over the ground in the direction of the current, the material having first been placed on the sledge in a folded condition with one end anchored at the starting point.

Weighting of the Mat

Owing to the absence of cross-stiffening, the material buckled into folds. An improvement was effected by inserting tubes, held between double seams, but this led to a further complication as, when the sea bed was uneven, the edges of the mat were kept off the ground and allowed water to penetrate under the mat and so lift and displace it. It therefore became necessary to weight the mat with stones immediately it was laid down, which proved cumbersome and was not always successful.

The next step consisted in providing the sledge with rollers and in a change of method. The nylon mat was now slipped over the front rollers and the sledge made to pass over it, smoothing it out while it was doing so. These tests established the fact that the mat must be stiffened. The first idea then was to divide it into squares, like the flexible reed cushions of the traditional dyke foundations, to be subsequently loaded with ballast. Later tests made it evident however that this way of proceeding allowed only bracing in the direction of the laying-down—not cross-bracing. At the same time, the braces had to be such that they could adapt themselves readily to all uneven surfaces of the ground, and heavy enough for the mat once it had been put down to remain flat for some time at least, even without any ballast.

Success in this was achieved by fitting nylon tubes on the mat and filling them as full as possible with sand before sinking the mat. The filling was done simply and quickly by injecting a mixture of sand and water into the tubes. The water runs out and the sand remains. Mats made in this way were laid satisfactorily. They went down evenly and smoothly with the rollers, as they passed over, acting as a steam roller does on a new road surface.

It now remained to be seen how the mats would behave on an uneven surface—would they adapt themselves to its irregularities? To test this, experiments were carried out on land. They made light of the difficulties of terrain, but when the mat was subjected to a cross current after it had been laid, the edges were liable to shift and were not firm enough to hold. To remedy this, the nylon mats were bordered with strips of nylon net, and sand-filled nylon tubes were fitted at 4-foot intervals. The weight of the net was increased by the addition of supplementary sand-filled tubes projecting beyond both ends of the mats, where the effect of currents is always at its strongest.

Layout of the Pontoon

In its present form the pontoon is a moving store for the nylon matting, resting on fore and aft rollers which also serve as floats. The rollers are divided into three sections, each provided with water inlet valves, so that the pontoon can be given any desired floating capacity. The outer sections are inter-connected and the middle section acts as a trimming tank. The rollers must be able to follow every change in the level of the ground, which means that the pontoon must be flexible. To achieve this, the sides of the outer floats were made as thin and light as possible consistent with required strength, so that they could "give" easily, and the rollers were provided with self-adjusting bearings. To keep the total weight as low as possible, the floor of the mat storage space was made of electrically welded wire netting.

A girder placed above the front roller, joined at its outer ends to the pontoon, presses the mat material against it, acting as a brake against premature unfolding.

Power to move the whole contraption comes from a floating derrick, steering resistance against which is provided by the pontoon's rear anchor. For greater stability in surface movement, easily removable additional floats are used. The total weight of the roller-pontoon is over 22 tons when in full trim ready for use, with a loading capacity of 20 tons.

Dislocation of the edge of the nylon net held between the front roller and the girder, either before or while the pontoon is being sunk, is prevented by suspending a sand-filled bag of the same length as the front roller over the girder. When the water inlet valves in the rollers are opened and the extra floats are removed, the pontoon sinks. Buoys and markers indicate the precise sinking point and the exact path followed by the pontoon as it is dragged along the bottom.

Loading of Matting

On account of the care required, the loading of all the foundation material is done in harbour. It is brought to the quay-side in long reels and is lifted by crane to position it right above the storage accommodation of the pontoon. It is then lowered in an operation synchronised with the sand-filling of the nylon tubes. This done, the pontoon is moved, afloat or suspended from a derrick, to the working site.

When it has been sunk, the retaining girder above the front roller is raised and fixed in the open position at the same time as the first trial forward pull is made by the accompanying floating derrick. The nylon material begins to unfold and the first buoys float up to the surface. Travelling light, the derrick then moves off to the far end of the laying-ground before the real drag begins. The pontoon now goes forward, laying the nylon matting on the bed of the estuary, its direction and progress steadily indicated by the buoys automatically released from the bottom as the nylon material unwinds.

B.T.C. Dredger Contracts

The British Transport Commission have placed an order with Seawork, Ltd., London, for the construction of a twin-grab diesel hopper dredger for use mainly at Grangemouth and Methil where over 400,000 tons of spoil has to be removed each year from the docks and their approaches. The vessel, which will replace several obsolete craft, will have a length b.p. of 190-ft., a moulded breadth of 37-ft., a moulded depth of 16-ft. and a carrying capacity of 1,200 cu. yards.

This is the fifth dredger contract from the B.T.C. for British shipyards this year. Richard Dunston, Ltd., have obtained an order for a hopper dredger 130-ft. long for King's Lynn; Charles Hill & Sons, Ltd., two hopper dredgers, one 214-ft. long and the other 156-ft. long, both for service at South Wales docks; and Lobnitz & Co., Ltd., a grab hopper dredger 200-ft. in length for use at Hull.

Licensed Wharfingering System at the Port of Melbourne

By T. J. Dwyer

The nice balance which has always been preserved in the port of Melbourne between port regulation and freedom of private enterprise within the port area, has played a significant part in smooth working, during the 82 year history of the Melbourne Harbour Trust Commissioners.

By statute of the Victorian Parliament the responsibility of the Trust to control and administer the port is unequivocally laid down in black and white. But wise statute which confers rights and powers commensurate with obligations has enabled many fundamental activities to be performed either by the Commissioners themselves, or by somebody **licensed** by the Commissioners to carry out the particular function.

In this way the Commissioners have been enabled to meet their accountability to the people who own the port—the people of Victoria—without themselves engaging in forms of activity which, long experience has proved, may more fruitfully be undertaken by private organisations.

It is in the Trust's licensed wharfingering system that this facet of port administration is revealed in one of its clearest forms.

Under traditional Bill of Lading conditions the responsibility of the shipowner for cargo carried to its destination port, ends with the discharge of the goods.

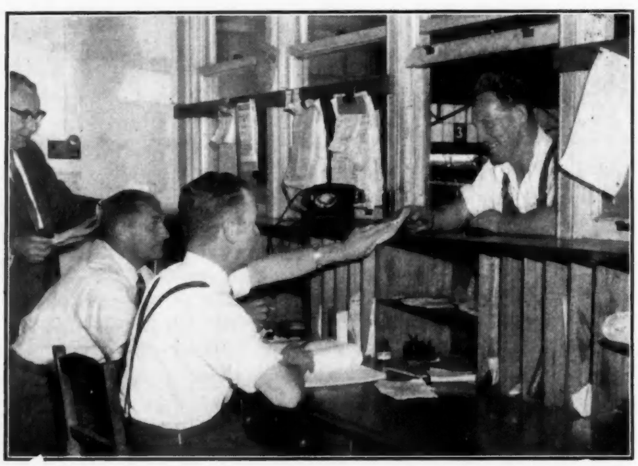
At this stage of physical discharge there are many systems employed in various ports of the world for the orderly handling, delivery or storage of the goods, the system employed depending on a number of historical, physical and other factors.

In the Port of Melbourne the licensed wharfingering regulations come into force.

By their enabling Act, the Commissioners are empowered to "establish and conduct business as wharfingers . . . or may . . . license any persons to act as wharfingers" for the reception of cargoes. They have the authority to become the physical entity into whose custody the goods pass on discharge from the vessel, for ultimate transfer to the possession of the rightful owner—the consignee, or they may license somebody else to carry out this function.

It has been port policy over a period of more than 40 years that no cargoes shall be discharged from a vessel unless into the physical custody of such an authorised authority, and in terms of the power conferred by the Melbourne Harbour Trust Act, two important regulations have been framed.

A truck load of paper halted at a Harbour Trust check gate for final clearance from the port area.



A shipping company representative in the cargo transit shed on the wharf endorses a bill of lading with the authority for the delivery of the goods.

The first (regulation 115) specifies that:

> "No goods shall be unshipped or deposited upon any wharf or road, or in any shed, unless same are delivered to a Licensed Wharfinger and until the Master, Owner or Agent of the vessel, from which goods are to be unshipped has delivered to the Harbour Master and the Licensed Wharfinger a statement signed by such Master, Owner or Agent, containing full particulars of the quantities and descriptions of the cargo which it is intended to unship."

Irrespective of Bill of Lading or any other conditions, the regulation makes it impossible for a vessel to unload its cargo unless into the custody of a wharfinger, subject to certain exceptions specified elsewhere in the regulations.

The second basic regulation (number 116) covers the issuing of licences and provides that:

> "No person shall act as a Wharfinger unless licensed by the Commissioners for that purpose, and all licences shall be issued under such conditions as the Commissioners may direct. The Owner or Agent of the vessel may be appointed as a Licensee."

Although the Commissioners may themselves act as wharfingers, it is port policy that private enterprise shall be permitted to undertake the duties.

Here, then, public regulation and private enterprise work in harness. On the one hand, the regulation that cargo must be discharged into wharfinger's custody means the orderly reception, sorting, stacking and delivery of cargoes and maximum possible protection for the consignee. On the other, the granting of licences enables private enterprise to become responsible for the activity.

In practice, the licensed wharfinger is almost exclusively the shipowner himself.

Taking out a license he retains responsibility for the security of the goods until the consignee takes delivery from him. In effect the Bill of Lading provision that the shipowner's responsibility shall end at the ship's side with the discharge of the cargoes, is continued until the consignee takes delivery of his goods in the shed or at the stack, or the lay-day period of three clear days after ship's discharge has expired.

Certain berths are exempt from the provisions of the system because of the nature of the berths themselves or the types of cargo handled. For example, several port berths where coal is handled as well as oil berths, and open berths employed in the gypsum, sugar and phosphate trades are exempt.

For receiving, stacking, holding, and delivering goods the licensed wharfinger is empowered to levy a charge which is

specified, and varied from time to time, by the Commissioners. It is a practice of the port that the stevedoring company collects this levy direct from the consignee.

The consignee takes delivery from the licensed wharfinger at the shed or transit area. His Bill of Lading is endorsed by the shipping company for delivery of goods " subject to endorsement by Stevedoring Company to the effect that payment for stacking cargo has been arranged."

On payment of these charges the stevedoring company endorses the Bill of Lading or Delivery Note.

Customs clearance is given in accordance with procedures laid down by the Commonwealth Government. Duty having been paid and, where applicable, import licence formalities met, a Customs warrant number is affixed to the Bill.

The fourth body from whom clearance must be obtained is the Melbourne Harbour Trust, and this is obtained on payment of wharfage.

The Bill of Lading is endorsed " Please Deliver " and the consignee or his agent—usually a carrier—may now present the Bill of Lading to the ship's delivery clerk on the wharf and take delivery.

At the shed door or at the back, the load is checked on to the vehicle by the tally clerk who issues an interim pass which the carrier presents at the wharfside ship's delivery office.

Wide road approaches to transit sheds and all weather loading protection by an overhanging roof, help carriers to handle cargo to and from the sheds.

A " Permit to Remove Goods " from the wharves is issued by this office on a form supplied by the Trust to licensed wharfingers. This the driver presents at the exit gate from the compounded wharf area and his load is checked physically by police or other agents of the Commissioners, to ensure that load and permit tally.

The result of this close attention to detail, allied to regulation, compounding and physical check, is that pilferage in the port is of negligible proportions.

The reception of cargo at the ship's side after discharge is a problem which exercised the minds of the Commissioners well before the turn of the century, and as far back as 1890, consideration was given by the Trust to taking delivery itself of all cargo from ships, tallying it, placing it in sheds, and ascertaining correct wharfage rates to be paid.

This was apparently to safeguard the Trust's revenues rather than the merchant's interests.

The question became prominent once more in 1905, when the Melbourne Chamber of Commerce agitated for the Trust to act as wharfingers. The law at the time was to the effect that if goods were proved to have been landed, they were the responsibility of the consignee for any loss.

In consequence the consignee received little protection. A

A tally clerk checking timber cargo onto a truck before removal from the wharf.

committee was appointed by the Commissioners to investigate the matter, but its report opposed the Trust assuming wharfinger's responsibilities.

Agitation continued up to 1912 when an amendment to the Trust's Act empowered the Commissioners to conduct business as wharfingers. A later amendment permitted the issue of licences to wharfingers.

Although in 1913 the Commissioners agreed that " someone should be responsible for the goods until handed over to the consignee," there was difficulty in winning agreement from shipowners on the type of responsibility which should be brought into being. Conferences in 1914 and 1915 were carried out to the background of the stated Trust position that " if the shipowners or their agents are to act as wharfingers, the wharf would be considered part of the ship as far as liability to consignee is concerned."

Much of the port area was compounded by the Trust during the prolonged period of these negotiations and by January 1st, 1917, when agreement was finally reached, the licensed wharfingering regulations, in substantially their present form, were able to operate effectively from the outset.

In deciding to licence wharfingers, and not undertake the work themselves, the Commissioners felt that private enterprise was

Cargo in a transit shed awaiting delivery to the consignee.

potentially more capable of carrying out the activities flexibly and economically. It was felt that the shipowner, or his agent, would become the licensed wharfinger and so in effect the ship would carry responsibility right through until the consignee took delivery.

This expectation was met fully, and in the 42 years which have since passed the system has amply justified the most sanguine expectations.

Where the shipowner or his agent takes out a wharfinger's licence, the Trust asks for no returns from the Master of a vessel—and the agent settles claims for any losses, whether from ship or wharf.

A further advantage has proved that under single control, the supervision of men engaged in discharge of the ship, and those on the wharf, is carried out by one supervisor. Gangs can be picked up on the overall ship and wharf requirements of the ship's discharge, and manpower be freely transferred as required between ship and shore.

The orderly reception of cargo from ship and its sorting and stacking; its delivery to the consignee or his agent under closely supervised conditions; protection for the shipowner and merchant alike by the Trust's compounding system and physical check at exit gates; facilitation of documentation procedures; efficient use of waterside labour on ship, wharf and in shed; and overall smooth working of an established and proved system are all intrinsic in the licensed wharfingering practices of the port.

Public and private enterprise combine for overall port efficiency and economic working.

New Approach Jetty at Swansea

King's Dock Entrance Lock

The newly-constructed Approach Jetty to the King's Dock Entrance Lock, Swansea, was inspected early this month by a large number of representatives of Shipowners, Shipping Agents, Traders and other port interests. The party was conducted by Mr. Jeffers, the Chief Docks Manager, South Wales Docks and Mr. W. A. C. Morris, the Swansea Dock Manager.

Aerial view of Swansea Docks showing the new Approach Jetty.

This new Jetty is part of a £950,000 scheme of improvements authorised by the British Transport Commission, to meet the modern requirements of shipping. Other main features of the scheme include the major reconstruction of a shore roundhead at the entrance lock, extensive dredging in the entrance channel, and the construction of a new impounding station equipped with two new electrically operated pumps, each with a capacity of 100,000 gallons per minute. When completed, the scheme will enable the larger vessels calling at Swansea to stage-in from sea, thereby expediting locking operations, and also ensure that maximum water levels are maintained within the docks.

The Jetty is 977 feet long and is sited on the east side of the entrance lock to the King's Dock, at an angle of 24° to the line of the lock. The main structure consists of a reinforced concrete hammer headed slab 23 ft. wide, carried on Rendhex No. 4 steel box piles 60 ft. long driven in A-frame form each bent consisting of two vertical and four raking piles every 20 ft.

The main slab, which lies at a level between Spring tides and Neap tides, supports a superstructure of pre-cast reinforced concrete portal frames upon which pre-cast pre-stressed concrete slab decking is laid. The width of the deck is 20 ft. The Jetty is provided with sixteen 60-ton bollards at 60 ft. intervals, for the mooring of vessels. In front of the concrete and steel structure is an independent framed fendering system consisting of twin greenheart fendering piles at 10 ft. centres, faced with 12 ins. x 12 ins. greenheart vertical beams and walings. The timber fendering is cushioned off the concrete hammer headed slab by heavy circular rubber blocks 21 ins. diameter by 2 ft. 4 ins. in length, suspended on galvanised steel chains.

The Jetty is provided with lighting columns at 60 ft. centres with 60 watt sodium lamps At the seaward end, there is a navigation light fitted with a 250 mm. port light in accordance with the requirements of Trinity House. The Jetty is provided with two shelters for the docking staff, and near the inner end will be accommodated the automatic tide recorder which has been provided at the port. The steelwork in the jetty is equipped with cathodic protection.

The Consulting Engineers for the design and construction of the jetty were Messrs. Rendel, Palmer & Tritton, working in conjunction with the Commission's Civil Engineer for the South Wales Docks. The contractors were J. L. Kier & Co. (London) Ltd.

New Buoy for Shipping and Petroleum Transport

On 21st July last, a novel and revolutionary buoy was demonstrated by the Swedish Navy.

The "Imodco" Buoy is a patented offshore loading and discharging terminal capable of handling tanker ships of any size or capacity. Because of its revolutionary design, the buoy can be built and installed at a price considerably lower than any dock or existing type of offshore station. Furthermore, the designers claim that the buoy can operate efficiently even in areas where all other terminals would be either impractical or economically unfeasible.

The buoy is manufactured in several shapes and sizes to fill specific requirements: from 3 metres (9.84-ft.) diameter to 12.5 metres (41.01-ft.) diameter. The buoy of 12.5 metres can accommodate the largest ships now in service or contemplated, including super-tankers of up to 100,000 tons. In most cases the tanker's own pumps are adequate to transfer liquid cargo to the shore. However, at extended distances additional shoreside pumping stations may be readily employed. In loading, either pumps or gravity-flow from the shore may be utilized. For certain military purposes or when the water space is needed for manœuvring of vessels, the buoy may be easily equipped for automatic submerging from ship or shore.

Cargo

The new buoy can supply every kind of ship with bunkering oil, and service all vessels carrying any type of liquid cargo, particularly the following:

1. Petroleum oils and their distillates, including high octane gasoline.
2. Vegetable oils, coconut oil, linseed oil.
3. Special oils such as whale and fish oils.
4. Citrus juices.
5. Molasses.
6. Fresh water.

It can also be adapted to transfer certain solid cargoes. In addition, it can serve an important function in storing liquids and discarded oil (spill-oil), which is a constant danger to fish and animal life and to waterfront property and beaches.

Design

Basically the buoy is a large circular structure, not unlike a ship's buoy, which is firmly secured to the sea bottom by anchor cables and which permits submarine pipelines to pass through it. The buoy is so constructed that a ship moored by bow or stern can swing 360° around it, always heading into the wind or current, which ever is stronger. This allows the vessel to withstand gales up to hurricane force in greater safety than provided by a quay, existing offshore stations or its own anchors.

In actual operation a ship passes a heavy bridle to the buoy where it is secured to a specially designed hook. The buoy's hoses are then coupled to the ship's loading or discharging connections and cargo transfer proceeds through the submarine pipelines.

Location

The buoy can be installed in waters not protected by natural or artificial harbours and may be located as far from shore as required. It can be placed off any coast or in any bay, harbour or river where the depth of water is sufficient for the draft of vessels using the station. Under normal circumstances adequate clearance should exist for ships to swing 360° around the buoy. However, in restricted waterways where a vessel cannot be allowed to swing, an auxiliary mooring method may be employed. The ship is held in place by either a small bow or stern mooring buoy or the vessel's own anchor. For example; when a bow anchor is used, the ship is secured to the "Imodco" buoy stern-to. Also, on certain types of craft the engines can be turned over to maintain the desired mooring position, making an auxiliary buoy or anchor unnecessary.

All-weather Operation

Because of the buoy's unique mooring arrangement, ships can be secured to it in winds during which other offshore terminals cannot be approached and when even docking would be impossible. No intricate manœuvres are needed to reach the Station and once moored the vessel rides at her most comfortable position. Only the most severe storms can interfere with loading and discharging.

Since securing to the buoy is a simple task and requires only a minimum of hands and gear, servicing can be accomplished as efficiently at night as during the day and with equal safety.

A tanker of the Swedish Navy discharging oil offshore while secured to the new buoy.

The following are some of the advantages claimed for the new buoy:

1. Allows liquid cargo to be delivered anywhere—directly to the areas of use, without the aid of docks or harbours. This feature makes possible, among other things, the delivery of petroleum to the closest vicinity of factory sites, providing access to new areas for industry.
2. Makes possible savings in real estate, installation, overhead and operating expenses of an oil dock. It costs less than other terminals of equal capacity and can be operated at less than half the expense.
3. Can release valuable dock space to other commercial uses.
4. Substantially reduces the time a vessel must wait for loading or discharging facilities.
5. Permits oil from newly tapped fields to be easily transported by tank-vessel from the nearest coastal point, bypassing the construction of costly pipelines to a suitable harbour and expensive terminals.
6. Precludes fire and disaster hazards in congested or populated areas and localizes all fires, no matter how extensive, to the ship itself.
7. Greatly minimizes the risk of collision in crowded harbours where vessels must be guided into position at a dock or station. A ship approaches the buoy straight away at slow speed. No manœuvring is required.

8. Lessens the danger of harbour and sea pollution by oil, which in serious cases can cause a complete closing down of port operations. Contamination of nearby beaches and inside harbour works is avoided.
9. Makes practical the location of oil tank storages in localities remote from population centres.

Installation

The buoy can be installed with a minimum of equipment and labour—towed to the site—or prefabricated, shipped to the locale and assembled in a short time by semi-skilled workers. Then, using the buoy itself as a barge or another available carrier, the station and its anchoring devices can be easily moved to the exact location and quickly moored. The submarine pipelines containing the hoses are then affixed to the buoy and its complementary storage facilities ashore. This entire process can be completed in only a fraction of the time needed to construct even the most ordinary dock. At any time thereafter the buoy can be disassembled, transported or floated to another location with little effort and without the loss of its original investment.

The " Imodco " buoy is a product of AB International Marine and Oil Development Corporation, a Swedish firm composed of American and Swedish engineers and businessmen. The first buoy was constructed from designs evolved between their engineers and one of Imodco's directors, Leroy M. Sylverst. World patents are pending on the buoy and its complementary equipment.

Manufacturers' Announcements

Decca Navigator for the Persian Gulf

The Decca Navigator Company have announced that the Persian Gulf Lighting Service has placed an order for the supply and erection of two Decca Navigator Chains in the Persian Gulf. It is planned that the chains will be brought into operation at the end of the year, and will provide a continuous navigational service as in Europe and Canada.

The Persian Gulf is becoming increasingly important. Every year millions of tons of shipping pass through these waters and rely on the Persian Gulf Lighting Service for their navigational facilities. This adoption of the Decca Navigator System is yet another example of the steady growth of the System throughout the world. Together with the previously announced Chains near Bombay and Calcutta this new service will provide a further link in the series of Chains giving Decca Navigator Coverage to the Far East.

Protecting Structures from Corrosion

Estimates of the economic burden of corrosion vary widely, but by any count the cost to the nation of maintaining and replacing iron and steel equipment, structures and buildings is enormous. In many cases, the inevitability of rusting is taken for granted when comparatively simple and inexpensive measures could ensure almost indefinite life without the need for maintenance, such as regular painting.

A good example of the way in which such protection can be given, where in fact maintenance is impossible, occurs in connection with the new 850-ft. dry dock being built for Vickers-Armstrongs (Shipbuilders) Ltd, at Hebburn-on-Tyne. To support the dock walls in unstable ground without excessive weight of concrete, a framework of interlocking steel piles is driven round the line of the walls. These piles, which will eventually be incorporated in the thin reinforced concrete walls, are in turn anchored against a massive concrete beam some sixty feet beyond the walls, by a large number of tie-rods.

Once inserted, the rods must maintain their strength indefinitely. The soil is composed mainly of sand, gravel and clay, with an addition of slag tippings, and is very aggressive. The rods are therefore protected with materials made by Winn & Coales Ltd, of London. The cleaned surface of the rods is first smeared with Denso paste, a petroleum-based substance containing inert siliceous fillers, with passivating and inhibiting additives. This covering is followed by two types of tape, applied as shown in Fig. 1. The first, or inner covering, is of Denso tape, which is an open-weave cotton bandage impregnated and coated with a material similar to the paste. The outer Denselt tape consists of a bitumen-impregnated hessian strip, which is heated before application, to form a continuous and impervious barrier to moisture and to withstand the abrasion inevitable during insertion of the rods. The simple wrapping machine used, which is adaptable as to diameter of rod or pipe and pitch of wrapping, permits rapid application, with consistent tension and overlap.

Fig. 1

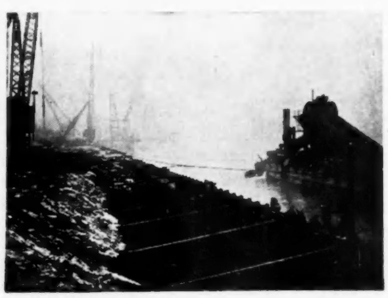


Fig. 2

Similarly treated rods are used to retain the piling for an adjoining new quay, illustrated in Fig. 2. In this case, attack by infiltrated seawater is the main danger. For convenience of installation, the rods are laid in excavated trenches which are later filled in.

Apart from the protection of buried steelwork and pipelines, Denso materials are widely used for the protection of all types of exposed steelwork, railway bridges, and similar structures, and for the waterproofing of insulated pipes; they form an economical and reliable wrapping for machine tools and equipment during sea transit, and offer a convenient means of insulating dissimilar metals to prevent electrolytic corrosion.

Metal Conditioner

Allweather Paints Ltd. have recently announced the introduction of a new anti-corrosive treatment which is marketed under the trade name Pitan Metal Conditioner.

This conditioner combines in one application a metal pre-treatment and the first coat of a paint system. It is effective on non-ferrous metals such as zinc, brass, copper, cadmium and aluminium; and has also been designed for steel and other ferrous metals, particularly where an early coating is required to protect it from corrosion. The conditioner forms an adhesive film over the surface and bonds itself into the metal. It has a high solvent resistance, and is therefore suitable as a primer for most types of paint, including synthetic finishes, stoving enamels and celluloses.